ELECTRICAL WORLD

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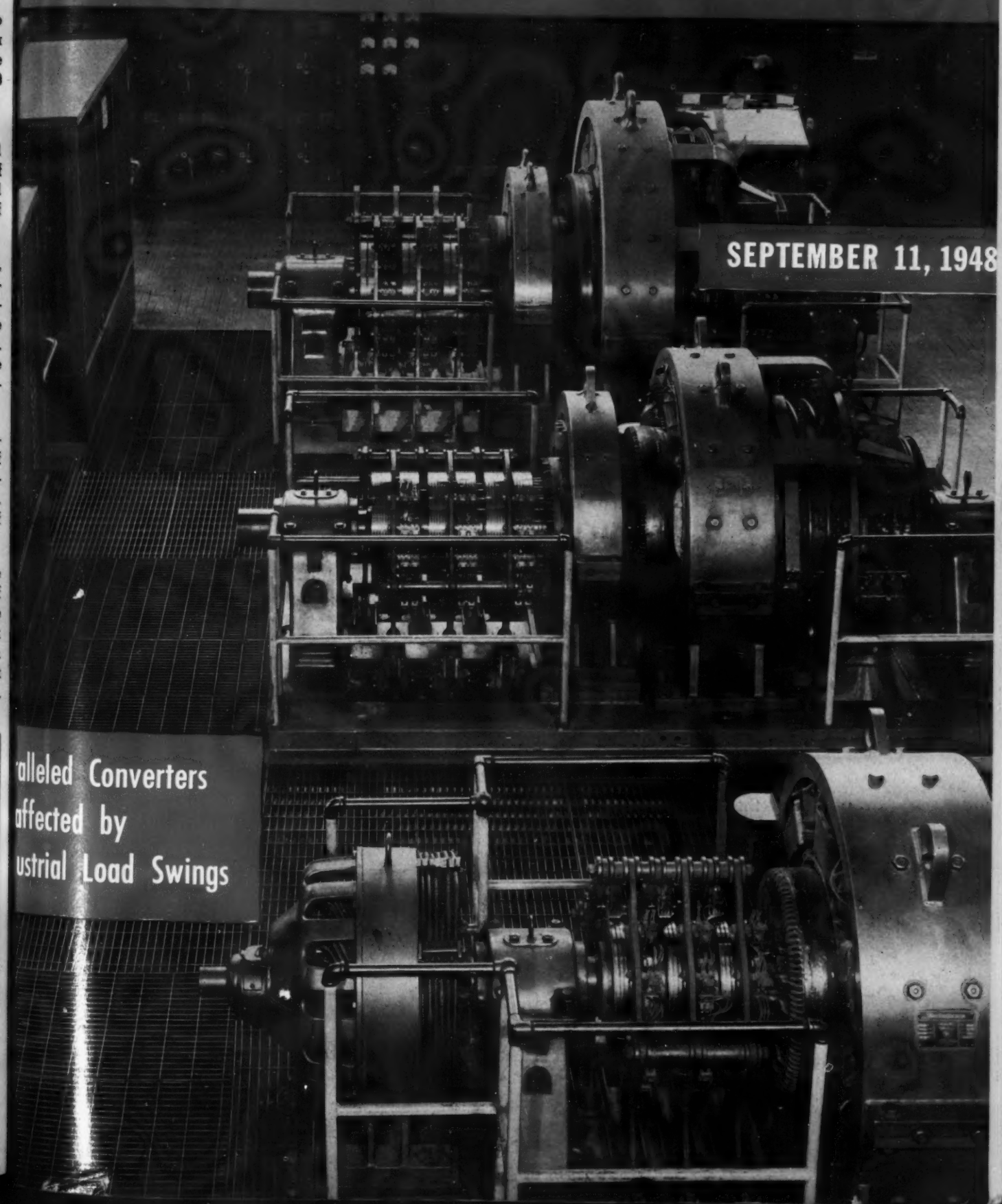

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ELECTRICAL WORLD

Published for 74 years for those engaged in the business of generating, transmitting, distributing or applying electric power

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Three of seven booster synchronous converters that supply 6,000 kw 125/250 v d-c power for Naval Gun Factory, Washington, D. C. Automatic control insures stable parallel operation despite a-c voltage variations or sudden changes in d-c load

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COMING IN THE SEPTEMBER 25 ISSUE

Kern Station Built Around Centralized Control
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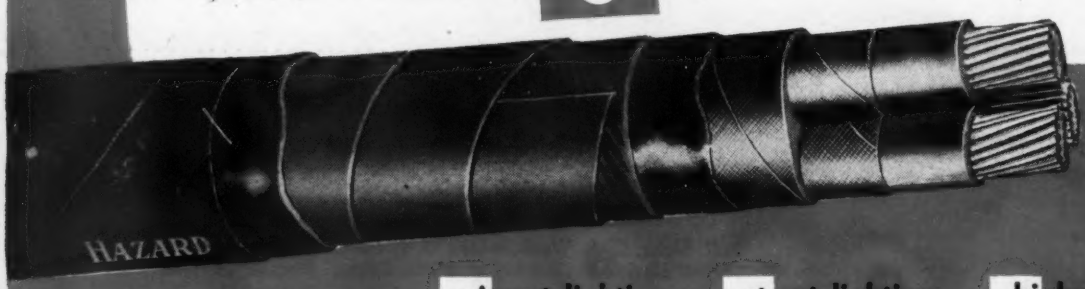
Economics of Subtransmission—Part II

SAVE 4 WAYS WITH HAZARD ARMORTITE CABLE ON THESE 6 IMPORTANT JOBS:



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The Industry's Power Policy

It's pretty late, perhaps, but there's an increasing feeling on the part of top electric utility management that the time has come for the industry to unite on a sensible, realistic policy with regard to the federal government's excursion into the electric power business.

To any such sentiment, ELECTRICAL WORLD says "Amen." Having blessed it, we hasten to add that the policy advanced must be both sensible and realistic. It must be simple and direct. It must be capable of interpretation in plain language for Mr. Average Citizen.

The urge to adopt a policy presents a big problem, to be sure. How much bigger is the problem of laying out a policy which will be both sensible and realistic and which still will command broad enough support within the industry to merit the status of an industry policy? One has only to stop and consider the divergencies of economic interest, the disparities in political literacy, the geographical differences, the ownership variations and the personality fluctuations which abound among the policy-making executives of this industry to realize the dimensions of the problem—adoption of a sensible, realistic industry policy on the government in the power business. Does anyone need more to be convinced of the infighting which will have to go on before the industry will have the policy it needs?

This sounds alarmist, even defeatist. Can such a policy be adopted at all? The answer is that such a policy must be adopted, for without its adoption and vigorous prosecution, the operating companies will hang separately. Is this strong language? Then inquire as to the truth of it from the men who once operated the Tennessee properties—and don't forget the Nebraskans. Ask the Northwesterners as to their expectancy in the absence of a front which is sufficiently unified to be effective. Ask the Southwesterners if they expect to stand off the Southwestern Power Administration forever, single-handedly and without an industry rallying point. Or, if you know them, ask Washington's public power heavyweights whether private power disunity works for them. They love the operating executive whose system is 1,000 miles from the nearest federal dam and who just doesn't believe that the bell tolls for him.

Of course, there's another reason for the leaders to do something sensible and realistic about an industry policy. A few days after this is published, EEI's directors will meet to consider —and, as we hear it, probably adopt—an industry "public information program." (This, if it also be sensible and realistic, is another move to which we say "Amen.") Now exactly what will the industry do with a nice, shiny public information program except fight for its life? And how will it fight for survival without a pretty accurate count among the members as to who wants to survive and how much and under what conditions? That's all an industry policy on federal public power is—a pledge by the members that the line shall be drawn and it shall be drawn in thus and such fashion, and that who fights on that line fights there and nowhere else, for the common good as well as for individual survival.

More About Electrical Codes

AN AMAZING JOB of making a rather dull subject into one of outstanding interest was accomplished by O. K. Coleman in his article *Local Wiring Codes - - - Abolish Them* appearing in the August 14, 1948 issue of ELECTRICAL WORLD. He makes two highly important statements:

"A wave of special rules in local codes for electrical wiring is sweeping the country. Many of these rules deny the good sense and competence of the National Electrical Code by replacing its provisions with others less sensible and more restrictive."

Quoting further—

"Not all special rules are to be condemned as of unworthy purpose. Some of them have real merit. But where does their merit reside? Is it in safety or in some other consideration? If any such rule is in fact a contribution to wiring safety then it should be offered for inclusion in the National Code. Certainly its protection should not be held for the local scene alone; the whole nation should have its benefit."

Following on the heels of this article we receive notice of the progress made by the newly organized Electrical Section, of the National Fire Prevention Association. It appears that the Electrical Section is soliciting suggestions for changes in the National Electrical Code. Suggestions should be sent to the Secretary. They will be referred to the appropriate Code-Making Panel. Supplements to the Code are to appear annually except when a general revision is scheduled.

Here then is another opportunity for the various divisions of the industry to contribute to improvements in the National Electrical Code so that local codes will have less and less reason for existing.

Here is also an opportunity for the NFPA to bring in broader and more representative segments of the industry to assure full recognition of the resultant code.

A Pyrrhic Victory

THIS PARTICULAR POWER COMPANY does not merchandise appliances. It sells them though, sells a lot of them, by extensive and vigorous promotion of electricity uses in the home. The power company sells, and the dealers ring up the purchases on their cash registers.

If there is one group in the local population that, more than any other, should be an example for the rest in fullest use of electric appliances, it is the employees of the power company. Knowing this, the company wants to induce employee purchases by discounts.

There is nothing irregular in this. Practically every retailer allows discounts to his employees. Why should not the power company? It sells appliances, even though the resulting purchases are made in dealers' stores.

But when the power company proposed that its employees should enjoy a modest discount on appliances, a loud howl went up from some dealers. It was useless for the utility to point out that the plan set up would return net profits to dealers because employee purchases would be channeled through them and the proposed discounts were only about half of dealer mark-ups. The dealer profit in each case would be entirely net because the power company would receive the appliance from the distributor, deliver it to the employee, collect for it, and then turn the money over to the dealer who would then pay the distributor's price for it and pocket the difference. Thus the dealer would make a nice profit on the sale of an appliance he never had in stock and to which was attached no cost for handling and selling.

But dealers had their way. The idea was abandoned.

It seems to us that in this instance the protesting dealers did a complete job of cutting off their noses to spite their faces. They sacrificed immediate and future profits for the doubtful pleasure of slapping at a power company that is building business for them. For what it was worth, they won a Pyrrhic victory.

Shedding Load in Emergencies

THE CUSTOMARY winter peak of Northern areas is not so far off. Regardless of the degree of margin in capacity that will prove later to have been available at that time, thought should be given now to the means for load relief. Interconnection operators know this.

Reduction in voltage or frequency, possibly both, has been the first step in recent practice. These methods have been effective apparently without notice by users of electric service. At least, most companies report very, very few complaints from customers—probably few knew their service was actually being tampered with.

Voltage is recognized as the sounder and safer resort. Even though it affords only a one-for-one percentage benefit in load reduction, it escapes some of the risks of frequency reduction. A reduction in station voltage means nothing at all unless the automatic correctives to sagging voltage out on the distribution system are prevented from ruining the desired results. Frequency is viewed by many as a second line of resort to apply after the voltage already has been reduced the permissible 5% or so. Incidentally, a reduction in frequency means an inherent reduction in voltage unless compensated by field rheostat adjustment. Reduced frequency gives a substantially larger proportional reduction, but it incurs the risk that power station auxiliaries will turn unstable; in this connection one must not forget the steep speed-output characteristics of certain types of pumps, fans, compressors, etc.

Some of the things brought out at the informal AIEE conference in Pittsburgh last winter are worth repeating. One is that loss in efficiency of refrigerator motors because of lowered voltage may more than offset the intended reduction in consumption. Fluorescent lamps (particularly the single-lamp fixtures) show about 5% increase in watts for a 1% lowering of frequency. Manifestly, the particular composition of any given system's load will determine what can and should be done.

NEWS OF THE ELECTRICAL WORLD

The Electrical Week

The Campaigning to induce federal responsibility for the power with which to supply increased aluminum load is out in the open. Bonneville Power Administrator Paul J. Raver "expects" that the federal government will have to supply most of the new capacity, and his estimates as to the capacity which will be required in the next dozen years are tremendous. His comment came before the Fall meeting of the American Society of Mechanical Engineers, of all places . . . In Washington, President Truman has seized upon the St. Lawrence Seaway and power project as one salient in the campaign against GOP Presidential nominee Dewey. Truman made it clear that he wants the whole project or no project, a stand directly opposed to Dewey's move which would hold the Seaway in status quo while pushing hard on the power development. Since mid-Westerners who want the Seaway have always fought bitterly against any division of the project between power and navigation, Truman's stand shouldn't be as harmful to him politically as it might appear at first glimpse. But it's hard to see where anyone will win or lose many electoral votes because of any stand on the St. Lawrence this year . . . The Rural Electrification Administration says that generating cost report by a number of mid-Western co-op people is strictly a phoney. The report asserted that studies of operating costs of three generating co-ops showed that the distribution co-ops could have saved a lot of money by getting their energy from existing suppliers. "Distortion" is REA's word for it . . . Up in Congress, the relations between the electrical manufacturers and the CIO United Electrical Workers are under examination. It looks as if industry people will be asked to testify, too.

By the end of 1948, it is estimated that there will be 65 television stations in 42 cities in 28 states. These stations will serve 900,000 sets and an audience of over 4,000,000.

"Unless unforeseen difficulties arise, there should be little or no voluntary load shedding (in Great Britain) next winter. The demand for power will be met by a two-fold system of regional load spreading during October, November, and March, and a national 20% reduction in consumption during December, January, and February." We agree with the *Electrician* from which this was quoted. There shouldn't be.

Because of the rise in fuel oil prices, Florida utilities have been forced to increase their rates. Now some municipalities are under the delusion that they can build their own power plants and save money.

Fame is fleeting in the labor movement. Marion H. Hedges, head of the IBEW Research Department for 23 years until he "resigned" last December, recently became a special assistant to the ECA labor advisers. An article in the AFL clipsheet on his new assignment made no mention of his former IBEW affiliation.

Outside of farmers, the utilities are hardest hit by natural disasters such as drought, hurricanes, fires, floods, snow, sleet, lightning, and wind storms.

CIO President Phil Murray's split with Lee Pressman, former CIO counsel, became complete after the CIO got the bill from Pressman and Charles J. Margiotti, former Pennsylvania attorney general, for taking the CIO test case on union political activity through the Supreme Court. It was $84,000.

The electric utility industry is one of the big customers of the natural gas industry using about 7% of the total natural gas marketed.

Ho-Hum Dept—Sen J. Howard McGrath, chairman of the Democratic National Committee, has attacked Republican Presidential nominee, Thomas E. Dewey, for "ducking the vital issue of public power." Perhaps, the New Yorker considers Communism and several other issues more vital.

It's a smart child who learns his ABC's these days. There are over 100 "alphabetical" agencies now functioning in Washington. The gamut runs from AAC—Air Coordinating Committee—to WAA—War Assets Administration.

Raver Predicts U. S. Will Supply Additional Power for Aluminum

NEW SUPPORT for federal assumption of responsibility for new power capacity required by an expansion of aluminum production facilities came this week from Bonneville Power Administrator Paul J. Raver.

With the American Society of Mechanical Engineers' Fall meeting, at Portland, Ore., as a forum, Raver declared that "it is expected that the federal government will have to supply most of the additional power requirements" for a vastly expanded aluminum production industry. This expansion Raver defined as requiring one to 2,000,000 tons above that existing this year. It will be necessary by 1960 and will require two to 4,000,000 kw of additional power capacity by that time, Raver added.

Raver's address followed a pattern which has become apparent in recent months. Federal officials, primarily of the Interior Department, and certain sections of the aluminum industry, have been campaigning increasingly for new federal power facilities to supply aluminum load.

TVA and BPA Main Power Sources

The Tennessee Valley Authority, Raver went on, and the Bonneville Power Administration now supply about 70% of the power used by the aluminum industry. He added that "the thoughtful citizen derives some amusement in contemplating a complete reversal of the position of those prophets of doom who doubted that the dams (Bonneville and Grand Coulee) would ever be used in the first place, and who were against further expansion at the close of the war."

Help War Expansion

"If the aluminum industry can build up its plant capacity to serve peacetime markets," Raver told the ASME group, "it will at the same time be providing capacity which can serve the needs of the country in times of national emergency, and thereby relieve the government of the corresponding costs in the event of such emergency. Of greater importance, such a program would save the time required to construct the necessary plants and facilities."

Aluminum industry officials, who declined to be named, were quoted recently as warning that the aluminum supply situation will worsen unless immediate steps are taken to enable the production of more metal. Before anything else, such a warning would mean more power capacity.

These same officials emphasized that such steps would have to be taken by others than the aluminum industry itself. Aluminum industry leaders insist they are producing to the limit in the face of a power shortage.

The shortage contention is attacked by certain power industry people who insist in turn that energy can be supplied by existing idle aluminum plants everywhere except in Arkansas. Price of any energy for such presently-idle plants, power people agree, would be well above that at which aluminum companies prefer to buy power. This is true because extra power today would be increment power.

There is no argument that power could be had today to meet all the load which would be thrown on the lines if production were to supply all the demand which the aluminum industry estimates to exist. But even if there were enough power for such demands, there isn't enough aluminum production capacity to meet today's demand estimates. So power system people feel that the aluminum industry's charges of power shortage are little better than the "chicken-egg—which came first" argument.

One of the difficulties against which the aluminum industry has been working is the loss in production which was suffered in Pacific Northwest floods.

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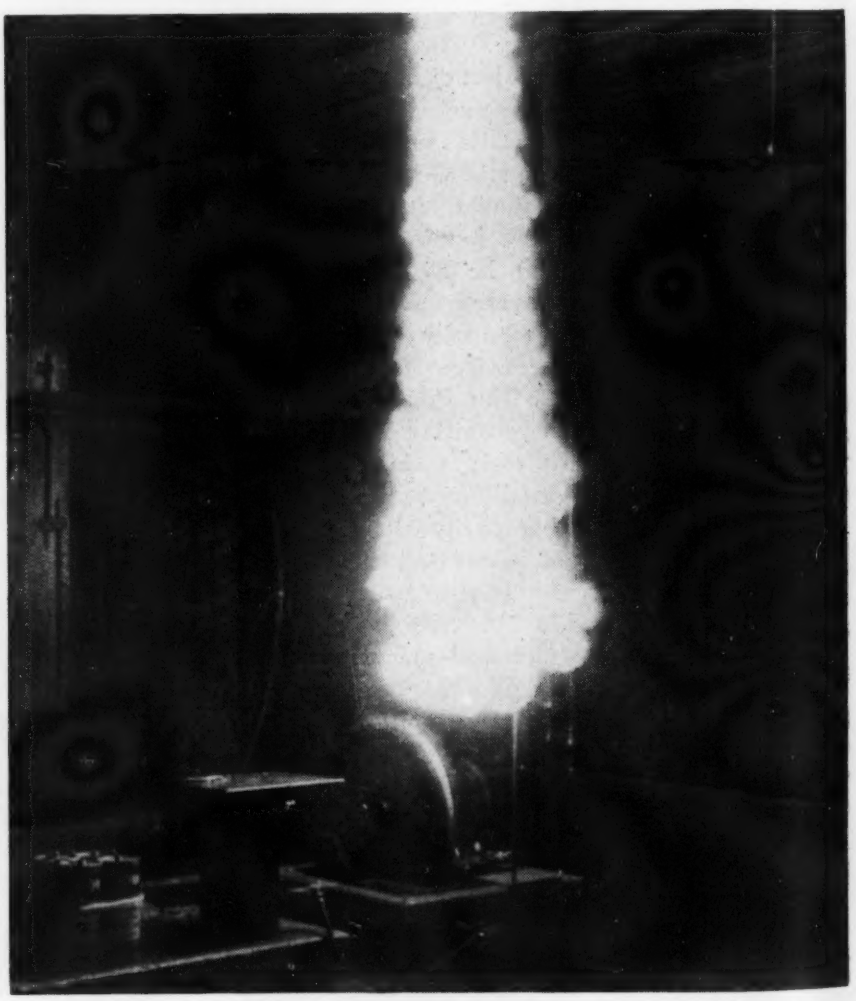
Aluminum Plant Needs Metal

Shortage of metal has forced curtailment of operations at the Alcoa, Tenn., plant of the Aluminum Co of America.



CARBON COPY of a lightning stroke is reproduced in the laboratory by Westinghouse scientists. Instruments atop the University of Pittsburgh's 535-ft Cathedral of Learning record a bolt's current, wave shape, duration and number of components. The laboratory copy then is tested for its effect on various materials and pieces of equipment

All or Nothing Is Truman View On St. Lawrence Power Program

IT'S POLITICS AS USUAL on the St. Lawrence power project—at least for the rest of this year.

President Truman says he won't buy the proposal of Tom Dewey's New York Power Authority to develop, jointly with Canada's Province of Ontario, hydroelectric power of the boundary stream. Give him the whole Seaway project—navigation as well as power works—or nothing at all, Truman insists.

That means the New York-Ontario scheme, which has been getting sympathetic consideration from the Federal Power Commission, probably will get no farther. It can't go beyond FPC unless, and until, Truman changes his mind or a new president gives it a push.

Protests Lacking

The President's statement, made at his press conference last week, stunned a number of administration power officials. No important protest had been lodged against the power project previously. And Harry Truman's good friend, New York's Senator Robert Wagner, had heartily endorsed it.

But the President told newsmen he will oppose "any efforts" to split navigation features from the power phases of the Seaway project. As far as he is concerned, he added, the "St. Lawrence program" will go through as planned (presumably by the Army Engineers, as a federal navigation-power development) or "not at all."

Some administration sources speculated that the President, caught off guard, perhaps spoke without giving "serious consideration" to the New York-Ontario plans. Whatever the circumstances, most observers agreed that he gave Tom Dewey a campaign issue of some proportions.

Democrats See Issue

Democratic Chairman McGrath and other party spokesmen have been needling the Republican candidate for further amplification of his views on public power. Dewey now can do some needling on his own. The 2,200,000-kw St. Lawrence development proposed by New York and Ontario would rank second only to Grand Coulee as a publicly-owned producer.

Meanwhile, there was no change in plans for the hearing to be held before FPC in Washington starting Oct 4. On the last day for filing formal protests the Commission heard from the National Coal Association, United Mine Workers of America, and the Aluminum Company of America and its wholly-owned subsidiary, St. Lawrence River Power Co.

FPC will act on the New York Power Authority's application for license of power facilities on the U. S. side of the international boundary. The Commission already has forwarded a copy of the application to the International Joint Commission, which must approve when, and if, the proposal clears FPC and the Canadian government.

The matter has not reached IJC, however. The State Department, as the official transmittal agency, is sitting on the plans, hints that it may have to send the matter to the White House.

Truman may take one of three steps. He could change his mind and send the New York-Ontario scheme on to IJC. Then, he could stand fast, but instruct the State Department to forward the proposal with a recommendation that it be rejected. Or he could direct State to hold up the plan indefinitely by referring it to other agencies for "comment." State already has started the latter procedure.

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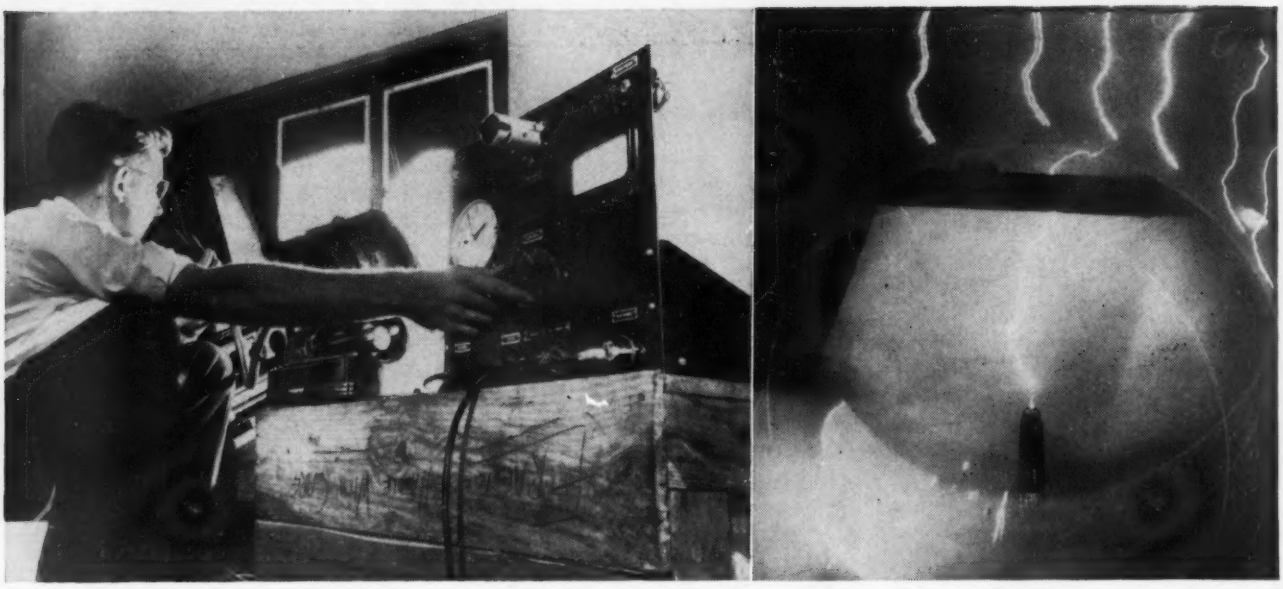
Wage Negotiations Opened Between Vepco, UWU

Virginia Electric & Power Co and the independent Utility Workers' Union have begun negotiations for a new agreement covering about 600 clerical workers.

The union has asked a 25% wage increase. The company's proposal, providing for an unannounced increase, was rejected. Technical and professional employees in the bargaining unit are asking a similar raise.

HARDEST WORKING RIVER in the nation is the way the Wisconsin Valley Improvement Co describes the Wisconsin River in this display at the Wisconsin Centennial at Milwaukee. Above is a general view of the relief model which WVIC caused to be made of the entire river basin. Below is a close-up showing some of the mid-stream hydro plants, including Wausau, to the right, then Marathon, Mosinee, DuBay, Stevens Point and Wisconsin River Division. The model had water flowing downstream and through the hydro plants



LIGHTNING WATCHER John Alger, of Massachusetts Institute of Technology, gathers data for use by General Electric researchers in protecting electrical equipment against lightning shocks. From a nearby building Alger photographs the Empire State Building, (right) a "lightning rod" for structures within a third of a mile radius. As storm approaches, he adjusts camera speeds (left) and reports to a dictating machine the nature and time of each lightning stroke

Henninger Made Director Of Publications, IES

Announcement has been made by the Illuminating Engineering Society of the appointment of G. Ross Henninger as its director of publications, effective Oct 1. The appointment of Mr Henninger is a further step in the Society's long-range program of development and extension of services to the lighting industry. To facilitate the operation of its expanded activities program, the Society has organized its headquarters staff into three correlated departments: general administration under Executive Secretary A. Dexter Hinckley; technical-committee and research activities under Technical Director C. L. Crouch; and publications activities under Mr Henninger.

For 18 years Mr Henninger has been a member of the headquarters staff of the American Institute of Electrical Engineers in New York, from 1930 to 1933 as associate editor and since 1933 as editor of *Electrical Engineering*. He entered upon his publishing career in 1924 when he relinquished his duties as a utility engineer with the Southern California Edison Co, Ltd, in Los Angeles to join the editorial staff of the McGraw-Hill Co of California as engineering editor of the then *Journal of Electricity*, which subsequently changed its name to *Electrical West*. Mr Henninger left San Francisco in 1930 to join the AIEE headquarters staff in New York.

Beginning January 1942, Mr Henninger devoted half his time for some six months to service as a special civilian consultant in the office of the Secretary of the Navy in Washington, D. C., in the development and establishment of personnel and facilities for the review and coordination of Navy publications. Later that year he was appointed a lieutenant colonel on the staff of the Director General of the Army Specialists Corps at its headquarters in Washington, D. C., and served for several months as a liaison officer, assisting in the procurement of specialized technical personnel for the Signal Corps and for the Army Air Corps. Then he was commissioned a lieutenant colonel in the Army of the United States and assigned for active duty at the headquarters of the Air Service Command at Patterson Field, Dayton, Ohio, where he remained until 1945. While on terminal leave, he was promoted to colonel.

G. Ross Henninger

As director of publications, Mr Henninger will correlate the publications activities of IES and will serve as editor of *Illuminating Engineering*, the society's monthly journal, which will be enlarged with its January 1949, issue, to include a broader range of text matter. He will be responsible for both its business and editorial development.

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Seattle Mayor Sees No Shortage on System

Although the Seattle, Wash., municipal supply is enough to maintain adequate service, the city must be prepared to help other areas of the Pacific Northwest if a shortage develops this winter, Acting Mayor David Levine has warned.

"If the Northwest experiences a low-water winter; if the water in the streams turns to ice or snow and does not melt, or if an important machine breaks down, then the Northwest will experience a power shortage during the winter months," Levine said.

"This will be true any winter until the McNary Dam and powerhouse, estimated to be finished in 1952 or 1953, is completed and operating.

"Engineers calculate that generator speed will at time of peak load this winter be below normal because the generators will be unable to swing the load and that electric clocks will run behind true time regardless of the water supply," he added. "If the water in the streams is below normal, a more apparent and serious shortage will exist."

REA Says Generating Cost Study of Three Co-ops is "Distortion"

RURAL ELECTRIFICATION ADMINISTRATION brands as a "distortion of facts" a recent study holding that costs of power produced by REA-financed generating cooperatives are excessive.

The power cost study, which was signed by officials of three REA-financed distribution co-ops, covered the financial status of three Mid-western generating co-ops. Cost of the energy produced during six years, the study contended, was 30% higher than the price at which power could have been purchased from other sources.

Haggard Makes Reply

REA's reply came this week (Sept 7) in the form of an official statement from Assistant Administrator George W. Haggard. It had been expected that REA would leave the job up to the generating co-ops involved. Apparently, the power cost report stirred such widespread interest that the agency felt compelled to issue its own answer.

The REA statement pointed out that the agency's policy is to grant generating and transmission loans "only in areas where there is an inadequate source of power or where a saving can be achieved by the consumers." This policy was followed, REA says, in the cases of the three generating co-ops covered by the cost study—Rural Cooperative Power Association, Maples Lakes, Minn.; Minnkota Power Cooperative, Inc., Grand Forks, N. D.; and Dairyland Power Cooperative, La Crosse, Wis.

Says Power Short

At the times these projects were financed, REA adds, "not enough power was available in the areas served by the co-ops to meet the farmers' needs." Further, before REA made the generating loans, "power companies in the area refused to serve distribution co-ops for less than at rates averaging 1.8 cents per kwhr. Such rates are exorbitant."

REA concedes that wholesale power rates in the area have been "reduced somewhat" since the loans were granted but argues they might not have been lowered had not the co-op plants been built. Had the "prevailing rates" at the time of the generating loans been continued, the agency argues, the savings to distribution co-ops and their members resulting from the operation of co-op plants would total $2,500,000.

The lending agency also assailed authors of the study for their failure to include 1947 in their estimates. During that period, REA says, the three generating co-ops had "excellent operating records," and "came within $84,000 of overcoming deficits accumulated during their construction period."

The cost study covered operations of the three co-ops for the period 1941-1946. It was completed in May, 1948.

The agency also attacks the methods employed in the study for computing depreciation. It says:

1. The 3.5% rate is unjustifiable.
2. Depreciation charges were made against such non-depreciating items as cash in the bank and land.
3. The co-ops were charged with depreciation on plant in process of construction during most of the period.

"The study implies the co-ops are 97.7% behind in the payment of their debt to the government," REA adds. "Actually, the co-ops have made substantially all debt service payments required under the long-term amortization schedule . . .

"The study indicates the construction of these generating plants deprived 30,000 farms of service. This is not true. Without these plants, the 78,500 consumers now being served by REA-financed co-ops in the area would have inadequate service at best, and many of them would have no service at all."

•

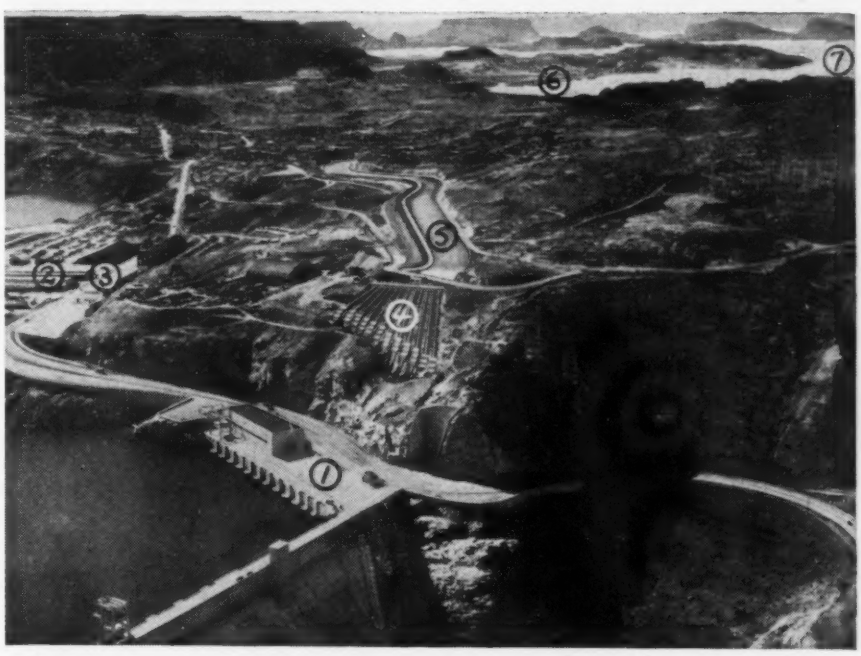
Set 1,100-Day Schedule for USBR Transformers

Moloney Electric Co has been awarded a record $765,982 contract to manufacture power transformers for the Bureau of Reclamation.

Moloney will supply seven 60,000-kva transformers for the Hungry Horse power plant in Montana. The contract calls for delivery of three transformers within 1,100 days of the date of the award, Aug 18 and the remaining four within 1,200 days.

Reclamation Bureau spokesmen said that bids for the 13,600-230,000-v transformers were asked so far in advance o assure the job a place on manufacturers' order boards. Congress will be asked for funds for the units next year.

Principal contract for construction of Hungry Horse Dam, located on the south fork of the Flathead River, near Kalispell, Mont., was let last April. The 286,000-kw hydro generating plant will be completed in the period 1952-54.



AERIAL VIEW of Grand Coulee Dam area in eastern Washington depicts construction program planned by the Bureau of Reclamation for the next few years. The cost will total several million dollars. Bids are now under consideration for completion of the Columbia Basin Project's main pumping plant (1) and Warehouses A and B (2), construction of a large machine shop (3), and installation of pumping plant discharge pipes and the headworks for the Feeder Canal (4). This part of the project will take about three years to complete. Future jobs shown are the Feeder Canal (5) and the North Dam (6), which will form a 27-mi Equalizing Reservoir in the Upper Grand Coulee (7) for the largest irrigation system of its type in the nation. Each discharge pipe will be capable of handling water for 100,000 acres of land. The pumping plant will contain the world's largest pumps and electric motors, the latter rated at 65,000 hp each

Congress Spotlights Relations of UE, Electrical Manufacturers

THE ELECTRICAL manufacturing industry's relations with the left-wing CIO United Electrical, Radio and Machine Workers have been thrust in the national spotlight by CIO Secretary-Treasurer James B. Carey, first president of UE.

After accusing the UE of being a Communist front, Carey testified before a two-man subcommittee of the House Labor Committee in Washington that some employers in the industry found it easier to deal with Communists in the UE than with the non-Communists. This was so, Carey asserted, because the Communist union leader "has to make compromises to serve his other interests."

Carey, leader of an anti-Communist faction—"UE Members for Democratic Action"—which is trying to unseat the left-wing leadership that took over from Carey in 1941 with Albert J. Fitzgerald as president, implied that some in the industry played along with the Communists to the disadvantage of the Carey faction.

Tried Buying Peace

They thought they were "buying a measure of industrial peace," but it was a dangerous long-term investment, he said.

Westinghouse denied Carey's statement that it fired Bart Enright from its elevator division in Jersey City because Enright, who unsuccessfully opposed Organizational Director James J. Matles' re-election last year, was fighting Communism.

The company said Enright, a production clerk, was fired for persistent absenteeism and tardiness, that he was warned several times and once laid off for a week, and that he was fired last October. Leave of absence granted to attend the UE convention was not counted in his absentee record, Westinghouse said.

Carey also charged that their anti-Communist activities were behind the discharges of an employee by RCA in Camden, N. J., and the dismissal of two employees working on Navy contracts at Westinghouse's Essington (Pa) plant. After Carey's intervention, the two were kept as employees, but transferred to non-secret work.

Carey, who testified under subpoena, asked Congress to leave to the union members the job of cleaning out Communists.

Fitzgerald, still president of UE, followed Carey to the witness stand to say that he knew nothing about Communists or Communist influences in the union of more than 500,000 members. Asked whether he thought Communists should hold union office, he replied that any law-abiding union member had a right to hold office.

Fitzgerald accused the subcommittee members—Rep. Charles J. Kersten, of Milwaukee, and Rep. Carroll D. Kearns, of Farrell, Pa., both Republicans—of being prejudiced against the UE because of the union's opposition to their re-election. A UE business agent, he said, is running on the Democratic ticket against Kearns.

Kersten, subcommittee chairman, expects to resume hearings Sept 28. Plans are under consideration for hearing from Westinghouse management and other employers in the industry. as well as from others in the union.

•

CEI Asks Industrial, Commercial Rate Boost

The Cleveland Electric Illuminating Co has asked the Ohio PUC for permission to raise industrial and large commercial rates. The proposed increase would affect about 2,500 customers and is estimated to yield a gross revenue increase of $4,600,000 yearly under present business conditions. The yield to net, barring further cost increases, would be $2,780,000.

CEI gave two reasons as justifying its request:

1. To attract the new capital required by system expansion.

2. To provide fair earnings and to protect the equity of present stockholders from further impairment.

The company's announcement implied that it does not necessarily believe that business will continue as favorable as its assumptions on gross revenue increases indicate. It implied further that more rate requests may be forthcoming, and asserted:

"The rate increases requested herein are not expected to improve revenues by an amount sufficient to provide an adequate return on the company's electric business."

The present increase was sought in industrial and large commercial rates, the announcement declared, because such business had been carried on at a rate of return lower than that on other business.

Concurrently with its rate increase request, CEI announced an increase of $22,000,000 in its construction program. That brings the total construction program to $127,000,000, of which work valued at $70,000,000 should be completed this year and next. Most of last week's $22,000,000 in additional construction will go into transmission and distribution, particularly substations, the company's announcement asserted.

•

ASA Combines All Poles in New Standards Code

The American Standards Association recently announced new American Standard Specifications and Dimensions for Wood Poles, (05.1–1948). It includes specifications and dimensions for all standard species in one document.

The new edition of the pole standard is a revision of the following: American Standard Ultimate Fiber Stresses of Wood Poles (05a–1933); Specifications and Dimensions for Northern White Cedar Poles (05.1–1941), for Western Red Cedar Poles (05.2–1941), for Chestnut Poles (05.3–1941), for Southern Pine Poles (05.4–1941), for Douglas Fir Poles (05.6–1941); American War Standard Specifications and Dimensions for Miscellaneous Conifers (05.7–1941).

In preparing the new standard, the sectional committee, headed by Dr Reginald Colley, Bell Telephone System, made several significant changes.

Several species covered in the American War Standard have made a place for themselves and are included in the new edition. Conspicuous among these are jack and red pine from the Lakes States area, Douglas fir from the Inland Empire, western larch, some western hemlock and Ponderosa pine.

American chestnut, old favorite of the eastern states, was reluctantly and at last eliminated entirely from the specification because it is no longer in commercial production.

Fiber stresses for the new species and those covered by the old standards have been brought into approximate relative position with respect to a relative strength line based on the 6,600 psi fiber stress for lodgepole pine poles.

The new specifications state that poles "are to be given a preservative treatment"; the specification lists none.

Another new provision is a standard branding system that will facilitate comparison of the different species under actual service conditions.

Copies of the new edition are available at 50 cents each from the American Standards Association.

Arizona Edison Gets OK for Largest Expansion

The Arizona Edison Co has been authorized by the Arizona State Corporation Commission to sell $300,000 worth of common stock to finance part of a four-year, $7,500,000 construction program, largest in the company's history.

The authorization followed closely approval to sell $1,000,000 in 3½% first mortgage bonds to the Northwestern Mutual Life Insurance Co. Proceeds will be used to retire bank loans made last fall when the utility purchased the Arizona properties of the California Electric Power Co in Yuma County.

Permission will be sought later this year to sell $1,500,000 of debentures and $3,000,000 in common stock to finance a portion of the construction program.

The company already has signed contracts for the purchase of three new gas Diesel electric generating units to expand its facilities at Yuma by 5,000 kw. Installation of the units is the first step in increasing capacity of the generating plant. A new building will be constructed adjacent to the present powerhouse to house the units and will be large enough to accommodate an additional 5,000-kw. generator. This phase of the program will cost $800,000.

Also included in the program will be installation of additional generating units in the Globe-Miami area, as well as at Coolidge, Casa Grande and Florence, with corresponding expansion of the distributing system. The Douglas-Bisbee plant also will be increased in capacity.

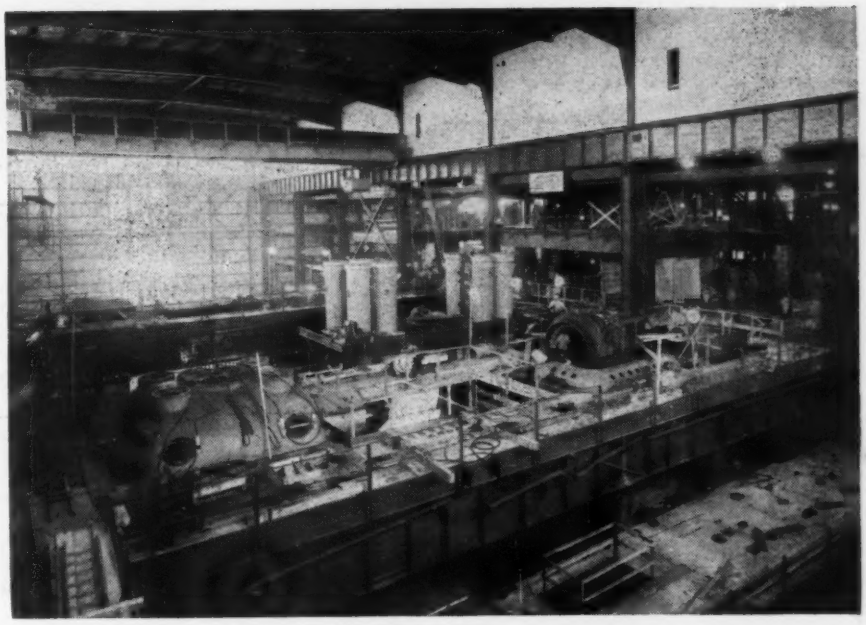
•

U. S. Court Gets Suit Against Ellis, NRECA

Appalachian Electric Power Co's libel suit against the National Rural Electric Cooperative Association and Clyde T. Ellis will go to U. S. court.

At a preliminary hearing in the Hustings Court for Roanoke, Va., last week, Judge Stanford L. Fellers sustained a motion by the defendants' attorneys for removal. The $50,000 civil action is expected to come before the next session of the U. S. District Court for Western Virginia.

The utility's complaint arose from statements allegedly made by Ellis, NRECA's executive manager, last May. Ellis, it was alleged, was attempting to block the proposed purchase of the Craig-Botecourt Electric Cooperative, of New Castle, by the company.



SEWAREN GENERATING STATION of the Public Service Electric & Gas Co, N. J., is well under construction. Picture shows the progress on the plant's first turbo-generator

House Group Probes Steam Plant Financing

A Congressional committee is investigating financial arrangements made by the Grand River Dam Authority for the purchase of a war surplus steam generating plant.

Members of the investigating staff of the House Appropriations Committee reportedly conferred with New York bond firms last week on the deal. They also are rumored to be studying the Federal Works Agency's role in the Oklahoma bureau's financing plans.

GRDA has proposed the issuance of some $8,300,000 in bonds to purchase the $3,500,000 plant from War Assets Administration, to make plant additions and for other purposes. The Authority already is indebted to the federal government to the tune of nearly $14,000,000. Federal Works holds GRDA revenue bonds for this indebtedness.

Investigators of the House Committee staff were not available for comment, but it was reported they would probe FWA's sanction of the new GRDA bond issue. The question of how the new issue would affect the status of the existing federal lien on GRDA's facilities apparently was the major issue involved.

FWA spokesmen said they had approved the proposed financing of the steam plant purchase. But, according to Assistant Administrator J. W. Follin, the new bonds would not subordinate the priority status of the existing GRDA bonds. The bonds held by FWA and the new issue, he added, would enjoy equal status.

The additional revenues accruing to GRDA as a result of the use of the steam power to firm Grand River hydro energy would "vastly improve" the position of the bonds held by FWA, Follin said. At the same time, he expressed the opinion that the deal would strengthen GRDA sufficiently to insure, also, the security of the new issue.

GRDA last year submitted the highest bid for the steam generating plant at the Oklahoma Ordnance Works, near Chouteau, Okla. But this proposal was protested by another bidder, Public Service Co of Oklahoma. A Congressional committee investigated the bidding, but the sale to GRDA finally was approved by War Assets after considerable delay.

26 Years, 1 Overhaul

Twenty-six years without an overhaul is the record of a 14,250-hp hydroelectric generator of the Washington Water Power Co. The unit, which was made by the General Electric Co, is rated 10,000 kw, 1,610 amp at 4,200 v. It is in operation in a plant on the Spokane River. During its first overhaul, completed recently, the only part which was replaced was the turbine bearing. This was made of South American lignum vitae wood. Another bearing of the same material was put in its place.

SEC RULINGS

General Public Utilities Corp has been authorized to make a $230,000 cash contribution to capital of Northern Pennsylvania Power Co, a wholly owned subsidiary. Northern Pennsylvania will use the funds for construction. (Release No. 8446).

Long Island Lighting Co and three of its subsidiaries have been ordered to recapitalize on a one-stock basis. All four companies have been directed to substitute for their existing preferred and common stocks a new common stock that would be distributed in a "fair and equitable manner" among present common and preferred stockholders. The subsidiaries are the Queens Borough Gas & Electric Co, the Nassau & Suffolk Lighting Co and the Long Beach Gas Co. The commission said that the fair and equitable distribution of the new common stock was a matter for future consideration with Queens Borough and Nassau & Suffolk. Under the plan, Long Beach would remain a subsidiary. Hearings on this plan are still in progress, and SEC said that its decision "should not be taken as any indication as to what action will be taken with respect to the proposed consolidation when the hearing is concluded." Recapitalization on a one-stock basis with respect to Long Island Lighting was required, according to the commission, in order to avoid a continuance of those "evils which the Holding Company Act is designed to eliminate, such as the burden of supporting an overcapitalized structure, the exercise of control through disproportionately small investment and the lack of economies in the raising of capital." (Release No. 8449).

United Public Utilities Corp has won approval for its plan to sell its interest in Citizens Heat, Light & Power Co to American Gas & Electric Co. United Public Utilities will make an additional liquidating distribution of $4 per share on its 370,300 shares of common stock from the $1,500,000 proceeds it received from sale of its interest in Citienzs Heat. After this cash sale, United's remaining subsidiaries will consist of two natural gas companies and one manufacturing gas company, all operating in the east-central part of Indiana. American Gas plans to eventually merge Citizens Heat with its subsidiary, Indiana & Michigan Electric Co. At the company's request, the commission will seek approval by the district court in Wilmington of these additional steps in United's liquidation. (Release No. 8453).

Commonwealth & Southern Corp's reconvened hearing on the plan for the retirement of its preferred stock has been postponed to Sept 14. It had previously been set for Sept 8. (Release No. 8456).

Public Service Electric & Gas Co's negotiated sale of 200,000 shares of cumulative preferred stock has been approved. The company postponed original bidding on the issue from July 7 to Aug 4, when bids by Union Securities Corp and White, Weld & Co, jointly, and Morgan Stanley & Co, New York, were rejected. Company had sought the action, contending it could get a better price by negotiation than by competiive bidding. The commission stated that a sale of these securities at an appropriate price at competitive bidding has now become unlikely, and in view of the company's pressing financial needs the commission determined to grant the requested exception, adding that company estimates that $64,000,000 will be required for construction purposes through 1949, and that it will also need about $58,000,000 to meet bank note and bond maturities. (Release No. 8457).

Potomac Edison Co, Hagerstown, Md., has been authorized to acquire additional common stock in South Penn Power Co and Potomac Light & Power Co, both of Martinsburg, W. Va. Potomac Edison will purchase an additional 160,200 shares of South Penn common stock for $801,000. It will also acquire 4,000 shares of Potomac Light common for $400,000. (Release No. 8463).

Kansas Gas & Electric Co, Wichita, has received authorization to solicit stockholder approval of an increase in its authorized common stock. Under the proposal, the authorized common would be increased from 600,000 shares to 1,000,000 shares, which additional stock may be issued and sold "for such considerations as the board of directors may deem advisable." (Release No. 8466).

General Public Utilities Corp's proposal to make a cash capital contribution to its public utility subsidiary, Jersey Central Power & Light Co, of $1,000,000 which will be employed by Jersey Central for construction purposes, has been approved. Jersey Central will credit the $1,000,000 to capital surplus. (Release No. 8469).

•

St. Louis to Sell Surplus Steam to Union Electric

Union Electric Co of Missouri will buy surplus steam from St. Louis's municipal power plant for about three years, under terms of a contract recently approved by the Board of Estimate and Apportionment. The city will net about $10,000 annually.

The utility is enlarging and modernizing its Ashley Street plant, which supplies steam heat for many office buildings and businesses in the downtown section. The municipal plant, where normally only two of four boilers are in use, was the only one able to provide steam needed during remodeling.

MEETINGS

PREVIOUSLY LISTED

American Society of Mechanical Engineers—Fall Meeting, Reed College and Heathman Hotel, Portland, Ore., September 7-9; Annual Meeting, Hotels Pennsylvania and New Yorker, New York, November 28-December 3.

Rocky Mountain Electrical League—Annual Convention, Hotel Colorado, Glenwood Springs, Colo. September 12-15.

International Brotherhood of Electrical Workers—Annual Convention, Ritz-Carlton Hotel, Atlantic City, September 13-17.

Instrument Society of America—National Instrument Conference and Exhibit, Philadelphia Convention Hall, Philadelphia, September 13-17.

Southeastern Electric Exchange—Engineering and Operations Sections, Vanderbilt Hotel, Asheville, N. C., September 16-17; Accounting Section, Sir Walter Raleigh Hotel, Raleigh, N. C., October 28-29; General Sales Conference, Atlanta Biltmore Hotel, Atlanta, Ga., November 10-12.

Interstate Power Club of New York—Meeting, Hotel Martinique, New York, September 20.

Iowa Utilities Association—Management Conference, Fort Des Moines Hotel, Des Moines, Iowa, September 20-21.

Illuminating Engineering Society—National Conference, Statler Hotel, Boston, September 20-24.

Missouri Valley Electric Association—Personnel Administration Committee, September 21; Rate Practice Group, October 7; Power Sales Committee, October 15; all at Hotel President, Kansas City, Mo., Accounting Conference, Connor Hotel, Joplin, Mo., October 21-22; Engineering Committee, Hotel President, Kansas City, Mo., October 26; Rural Round Table, The Elms, Excelsior Springs, Mo., October 27; Sales and Rural Conference, The Elms, Excelsior Springs, Mo., October 28-29.

Pennsylvania Electric Association—Annual Meeting, William Penn Hotel, Pittsburgh, September 21-22; Transmission and Distribution Committee, Bedford Springs Hotel, Bedford, Pa., October 7-8; Prime Movers Committee, Carver House, Warren, Pa., October 28-29.

Association of Iron and Steel Engineers—Convention and Iron and Steel Exposition, Cleveland Public Auditorium, Cleveland, Ohio, September 28-October 1.

International Association of Electrical Leagues—Annual Conference, Mayflower Hotel, Washington, D. C., September 29-October 2.

Canadian Electrical Manufacturers Association—Annual General Meeting, General Brock Hotel, Niagara Falls, Ont., September 30-October 1.

American Institute of Electrical Engineers—Middle Eastern District Meeting, Statler Hotel, Washington, D. C., October 5-7; Mid-west General Meeting, Hotel Schroeder, Milwaukee, October 18-22; Southern District Meeting, Tutwiler Hotel, Birmingham, Ala., November 3-5.

Edison Electric Institute—Prime Movers Committee, William Penn Hotel, Pittsburgh, October 11-12; Transmission and Distribution Committee, New Ocean House, Swamoscott, Mass., October 11-12; Electrical Equipment Committee, William Penn Hotel, Pittsburgh, October 14-15.

Indiana Electric Association—Annual Convention, French Lick Springs Hotel, French Lick, Ind., October 13-15.

Electrochemical Society—Fall Congress, Hotel Pennsylvania, New York, October 13-16.

Utility Workers Union of America—National Convention, Washington Hotel, Washington, D. C., October 15-17.

Wisconsin Utilities Association—Commercial and Technical Divisions of Electric and Gas Sections, Pfister Hotel, Milwaukee, November 1-3.

National Electronics Conference—Edgewater Beach Hotel, Chicago, November 4-6.

Public Utilities Association of the Virginias—Annual Meeting, Greenbrier Hotel, White Sulphur Springs, West Virginia, November 5-6.

National Electrical Manufacturers Association—Annual Meeting, Hotel Traymore, Atlantic City, November 8-13.

National Farm Electrification Conference—Congress Hotel, Chicago, November 17-19.

National Exposition of Power and Mechanical Engineering—Grand Central Palace, New York, November 29-December 4.

National Electrical Contractors Association—Annual Meeting, Roney Plaza Hotel, Miami, Fla., November 30-December 3.

Ontario to Restrict Use of Power from Sept 14

Restrictions designed to cut use of power in the Province of Ontario will become effective Sept 14, the Ontario Hydro-Electric Power Commission has announced.

Lack of rainfall in Quebec was given as the reason. The date was fixed following the decision by the Gatineau Power Co, Quebec, to reduce its supply of electricity to the commission by 1,000,000 kwhr a week at that time.

The regulations limit interior lighting of shops, show windows, and offices to 2w for each square foot of gross floor space, with this amount to be permitted only during business hours. Lighting of exterior signs, merchandising displays and outdoor athletic fields also is restricted.

Hot water heaters without insulation and thermostatic control will not be supplied with electricity. A ban is to be placed on outdoor advertising signs, decorative and commercial lighting, and outdoor Christmas trees.

•

Southwestern Pool Hit by Power Plant Blast

The Lieberman power station of Southwestern Gas & Electric Co, near Mooringsport, La. on Caddo Lake, will be out of service for two to three weeks following a gas explosion Sept 1.

The 25,000-kw. Lieberman station is a key plant in the Southwestern power pool, which includes 12 companies in 5 states.

Cause of the explosion in the boiler was undetermined, but damage was estimated at between $75,000 and $100,000.

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Adding 20,000-Kw Unit

Savannah Electric & Power Co is adding a 20,000-kw generating unit to its Riverside station. The $3,700,000 plant is designed to use oil and can be fired with natural gas if lines are extended to the city.

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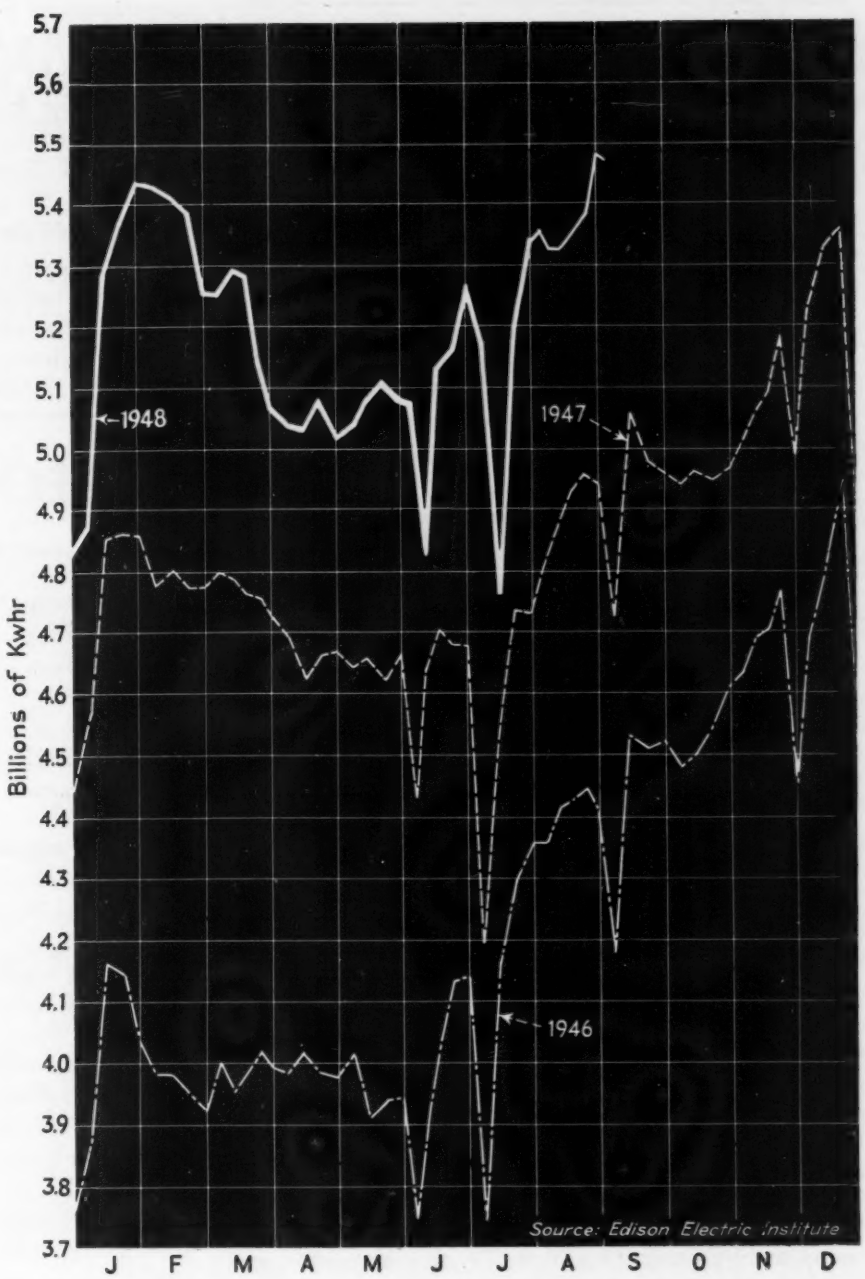


Arput Sneezes a Blast at the Utilities

ARPUT, who is the head sneeze of the Affiliated Hay Fever Sufferers, Inc., New York, is mad at the electric utilities.

"They're laying down—katchoo, akatchoo, sniff—on the job," he wheezed with teary, bloodshot eyes. "There are no humanitarian instincts in the entire —achoo—industry. It's just a power trust—kerchew. Why don't they get out and sell more air conditioning?" sneezed ARPUT, tossing away his 500th Kleenex.

"They don't care how we hay fever victims suffer—kachooie. And air conditioning makes our lives so much more comfortable. I hope every man who heads a utility, privately or publicly owned, gets it—achoo. The output last week didn't go down half as far as we are."

Weekly Output, Millions Kwhr

1948	1947	1946
Sept 4 5,470	Sept 6 4,721	Sept 7 4,184
Aug. 28 5,478	Aug. 30 4,940	Aug. 31 4,404
Aug. 21 5,391	Aug. 23 4,953	Aug. 24 4,444
Aug. 14 5,318	Aug. 16 4,923	Aug. 17 4,422
Aug. 7 5,319	Aug. 9 4,874	Aug. 10 4,412
July 31 5,352	Aug. 2 4,806	Aug. 3 4,351
July 24 5,342	July 26 4,730	July 27 4,352
July 17 5,197	July 19 4,732	July 20 4,293

Percent Change from Previous Year

	Sept 4	Aug 28	Aug 21
New England	+17.9	+ 6.2	+ 6.9
Mid-Atlantic	+11.7	+ 6.3	+ 4.6
Central Industrial	+17.2	+11.0	+ 7.8
West Central	+19.9	+13.6	+10.0
Southern States	+15.0	+13.2	+11.5
Rocky Mountain	+13.8	+11.8	+10.7
Pacific Coast	+17.8	+12.5	+11.3
Total United States	+15.9	+10.9	+ 8.8

WASHINGTON COMMENT

WILLIAM B. WHICHARD

STATUS of the St. Lawrence power project may not be seriously altered by last week's announcement from the White House that President Truman wants "all or none" of the Seaway.

Federal Power Commission is likely to go right ahead with its consideration of New York Power Authority's bid to erect power facilities in the U. S. portion of the stream. It more or less must do so. It already has set hearings on the license application for Oct 4. And there is no indication that White House pressure, which might prove ineffective anyhow, will be exerted to bar further FPC action.

Truman could keep the proposal out of the hands of the International Joint Commission, U. S.—Canadian board with jurisdiction over boundary waters. At most, such a step probably would be only delaying the inevitable —providing, of course, that FPC okays the New York-Ontario scheme.

The President need only instruct the Department of State not to transmit the proposal from FPC to IJC. And there is indication that he already has done just that. State has routed IJC's official notification through a sticky, though perfectly proper, procedural morass. How it did the job requires a little history—which also illuminates State's mastery of the intricacies of protocol.

When New York and the Province of Ontario agreed to build the power project, each assumed the obligation to seek the approval of its respective National Government. First step by New York's Power Authority was the filing of an application for license from the Federal Power Commission for power facilities to be built on the U. S. side of the border.

Under the International Boundary Treaty of 1909, it is up to FPC—and it has done so—to pass the proposal on to the International Joint Commission, which will have the final say.

Official transmittal agency for such documents is the State Department. Though IJC certainly is aware of the New York-Ontario plan, it can take no official cognizance thereof until State delivers the tidings, good or bad, as indicated by the administration.

But State is handling the matter as if it were an offer from Stalin to buy the Panama Canal. First, it is clearing the application with other departments, including the Army, Interior and Commerce. This step is a legitimate perogative of the department. But FPC, as a routine matter, must clear the project with the same agencies which will be seeing it a second time under state department auspices.

All this means that IJC cannot start its own rather involved handling of the case as quickly as had been expected. Part of this procedure is almost certain to be the staging of formal hearings in both this country and Canada. IJC's U. S. hearings might have been held jointly with FPC, as had been expected until State put the plan into the deep freeze.

Entire complexion of the matter, of course, will be changed if Governor Dewey wins the presidency in November. As sponsor of the New York-Ontario plan, Dewey would almost certainly apply the necessary heat in the proper places to get the matter before IJC promptly, without further red tape. Meanwhile, IJC, probably aware of political realities, is unlikely to be prejudiced by Mr. Truman's views.

TECHNICAL TRENDS

ARCHER E. KNOWLTON

Economizers are found to be largely self-cleaning, particularly the horizontal tube types, and soot-blowing is being removed or abandoned in many instances.

Exhauster blades badly eroded by the pulverized coal are being retrieved by spraying with a metal consisting in part of boron.

Standard capacitors as far down in the scale as one thousandth of a micromicrofarad have been provided at the National Bureau of Standards.

Farm-line continuity at 0.9 **kv** is forcing a choice between use of 20-kv gloves and hot-line tools.

Insulated climbers would be at least a partial answer to fatalities resulting from the metallic contact the lineman's leg-irons can inadvertently make with a conducting pole or grounded object.

Telephone messengers can be dangerous even 6 miles from a point of contact with a sagging 115-volt secondary. One lineman reportedly died from contacting the energized messenger.

Line-voltage regulation gains when a 3-phase regulator replaces 3 single-phase regulators and transformers. Further improvement in regulation should be available by means of inbuilt load-ratio control in lieu of a separate regulator.

Five million kw may be needed within a decade to handle low grade ore deposits. This is so because mineral resources in this country are gradually being depleted and the richer ores are vanishing.

Air cooling of railroad cars (particularly sleepers) at stations is creating a loading-platform distribution problem for railroad electrical engineers. How much circuit capacity, where run, kinds of outlet, plugs and portable leads are issues being sensed as demanding decision.

The Economics of Subtransmission—I

A long-range comparison of alternate subtransmission schemes seeking to determine the most economic arrangement to meet particular conditions. Particular emphasis placed on relationship between load-area coverage and distance subtransmission

D. K. BLAKE
C. A. WOODROW
and
O. B. FALLS, JR.
Central Station Engineering Divisions
General Electric Co, Schenectady

THREE DISTINCTIONS are commonly made in any large power system. They involve distribution, subtransmission and transmission.

But transmission and distribution are not mutually exclusive. They overlap functionally, and it is often difficult to draw an exact dividing line between them.

Circumstances have conspired in recent years to clarify the issue somewhat and an intermediate function "subtransmission" has won recognition. This is particularly true where metropolitan and semi-metropolitan systems have outgrown their original patterns. Many such systems were originally founded on centrally located power plants. Today system patterns are fast requiring new plant sites away from congestion. Frequently they are installed on a high-voltage ring or loop around the concentrated load area. Usually this calls for a distance voltage considered too high for economic conversion directly to distribution voltages.

Out of this situation a definite place has arisen for subtransmission, to link transmission and distribution. It partakes of the nature of both. It transmits and its also distributes but because it partakes a bit more of the characteristics of transmission construction, protection, operation and maintenance, it has been called subtransmission rather than super-distribution.

The distribution system overlays the load area. All except the biggest customers are connected to it. It is supplied by a subtransmission system which, because of its function, also overlays the distribution system and the load area to some extent. The transmission system links the subtransmission system and the generating source. It frequently involves considerable distances and the highest voltages.

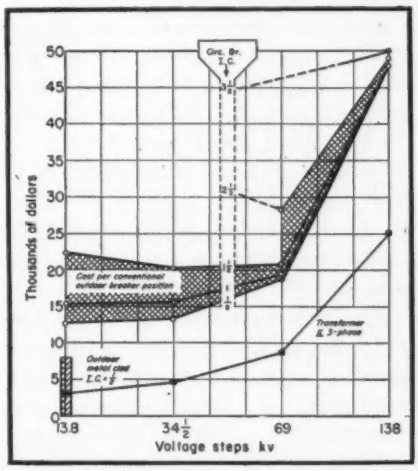


FIG 1—INSTALLED COSTS of outdoor substation components. Cost data charted is very approximate

Similarity of subtransmission to the distribution system offers opportunities for analyzing subtransmission economics by the same methods that have been successful in distribution studies.

The purpose here, and in the two installments that follow, is to make a long-range comparison of the relative cost of alternate subtransmission schemes to fit particular conditions.

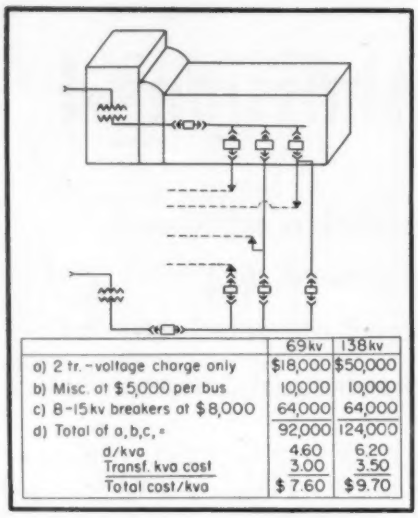
To obtain some ideas to try out on specific situations, it will be helpful to study ideal conditions and oversimplify the problem. Oversimplification proved its value in studies of distribution system economics and may be helpful in studying subtransmission economics also.

In the search for reasonable simplification eight concepts will be examined. They concern: (I) Voltage, (II) Load area size and system pattern, (III) The influence of the external source system, (IV) The transmission-subtransmission borderline, (V) Substation size and arrangement, (VI) Idealized application of radial distribution, (VII) Variations with distribution networks, and (VIII) The correlation of subtransmission and external systems.

I—Voltage. An adequate selection of subtransmission voltages can be made from any group of voltages having at least a two-to-one ratio between successive levels, such as 13.8 kv, 34.5 kv, 69 kv and 138 kv. These voltages are adequate for any condition of load area of any density known or foreseen.

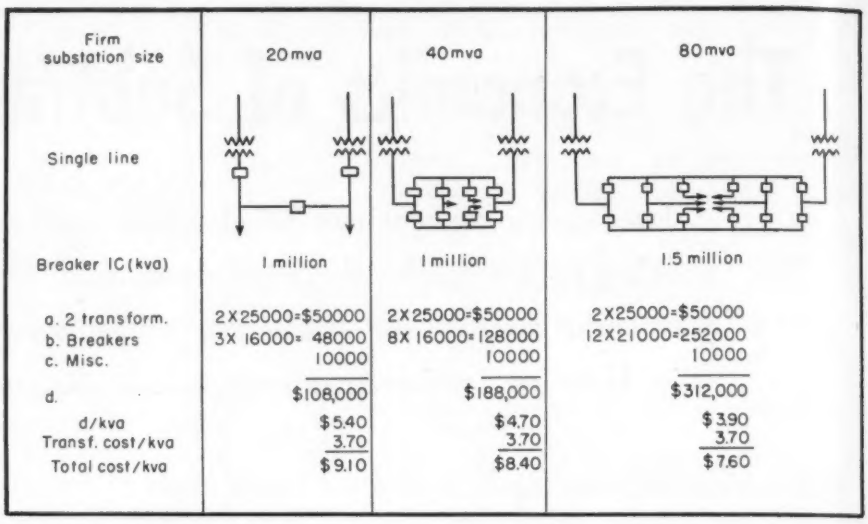
Though the cost of apparatus for 138 kv can be appreciably higher than for 69 kv, 138 kv must be considered a subtransmission possibility particularly where transmission system needs are adequately met by 138 kv. But where the transmission system demands 230 kv and power must be stepped down anyhow for subtransmission, the 138-kv level may often be by-passed. However, some engineers feel that transmission of tremendous blocks of power at 287- and 360 kv may be required in the future. If this materializes, circuit breaker short-circuit capacity bottlenecks or distance limitations may develop on subtransmission if voltages under 138 kv are used.

On some systems complications are created by too many voltages; espe-



	69kv	138kv
a) 2 tr.–voltage charge only	$18,000	$50,000
b) Misc. at $5,000 per bus	10,000	10,000
c) 8–15kv breakers at $8,000	64,000	64,000
d) Total of a,b,c, =	92,000	124,000
d/kva	4.60	6.20
Transf. kva cost	3.00	3.50
Total cost/kva	$ 7.60	$9.70

FIG 2—BASIC 20 Mva building block for any 13.8 kv low-side substation



Firm substation size	20 mva	40 mva	80 mva
Single line			
Breaker IC (kva)	1 million	1 million	1.5 million
a. 2 transform.	2X25000=$50000	2X25000=$50000	2X25000=$50000
b. Breakers	3X 16000= 48000	8X 16000=128000	12X21000=252000
c. Misc.	10000	10000	10000
d.	$108,000	$188,000	$312,000
d/kva	$5.40	$4.70	$3.90
Transf. cost/kva	3.70	3.70	3.70
Total cost/kva	$9.10	$8.40	$7.60

FIG 3—BUILDING BLOCKS for 34.5 kv low-side substation that it supplied at a voltage of 138 kv on its high side

cially in a given load area. Just the reverse is encountered on other systems. Such systems may have started with no transmission problems and original generation so well located that subtransmission at generator voltage carried no cost premium. But, during system expansion the single-voltage concept was carried too far.

Two subtransmission voltages are often desirable. More than two generally represent unnecessary complication and appear to be justified only under special conditions.

Most existing overhead subtransmission circuits are never loaded to the limits now possible in block power transmission. Rational kva loading of overhead or three-conductor cable circuits is about in proportion to voltage. In these discussions the loadings given in Table I will be used for both overhead and cable (except 138 kv).

II—Load Area Size and System Pattern. If 138- kv subtransmission is to be included, at least an 80-Mva load area must be considered since, in an emergency, it can be supplied by one 138-kv circuit. But, 80 Mva of fairly uniform load density is encountered only in large metropolitan areas. Therefore, some method of analysis must be used that will allow further sub-division.

Consequently a 20-Mva load area will be taken as the minimum basic area load in this analysis. It is the allowable emergency loading of one 34.5-kv circuit. The area must be overlaid with 34.5 kv or 13.8 kv so that, with one circuit out, firm power is supplied to distribution feeders.

On this basis, 20 Mva load areas can be coupled together to form either (a) larger areas of fairly-uniform load density, or (b) non-contiguous 20-Mva load areas served from the same transmission or generating station source.

III—The Influence of the External Source System. The choice of subtransmission source voltage may be influenced, and occasionally dictated, by the system external to the load area. If a very small load area comprises the entire system, then 13.8 kv may give the lowest source-system cost. But if the load area is a *small* part of a large system with 138-kv transmission, then 138 kv has a decided source-system advantage. "Source-System Cost" here includes generation, transformation and switching costs behind the take-off point for subtransmission.

For simplicity it will initially be assumed that source-system costs per kva are identical for 13.8-, 34.5-, 69- and 138 kv. Actual variations must, however, be reinjected when making a particular overall system analysis.

IV — The Transmission-Subtransmission Borderline. When and where is subtransmission no longer subtransmission, but transmission? The borderline is fuzzy!

This analysis is limited to 80-MVA load areas as a maximum with a firm power requirement of at least two circuits. At any reasonable distance this is too small a load for 138-kv block power *transmission.* On the other hand, no transmission engineer is interested in 13.8 kv for transmission. In between are two borderline transmission possibilities; (a) 69 kv where two circuits could be made to carry 80 Mva with 40 Mva nominal and 80 Mva emergency loading, and (b) 34.5 kv with 3 or 4 circuits handling 80 Mva of load. However, the heavier loading means added voltage drop difficulties. Also, cost reductions are little greater than can be obtained by using Table I loadings and two-circuit tower construction. Therefore

TABLE I—Circuit Loading and Cost

Voltage (Kv)		13.8	34.5	69	138
Normal Mva peak loading		6	15	30	60
Emergency Mva peak loading		7.5	20	40	80
Cost per Mile	Overhead	$12,000	$12,000	$16,000	$20,000
	3-conductor cable	$21,000	$30,000	$48,000	.....

*These costs:
(a) Do not include either right-of-way for overhead or the cost of digging and providing the underground duct bank. But, since low-voltage cables require more ducts space, $2500 per mile per cable has been included for all cables, for duct space.
(b) Include a loss evaluation of $5,000/mi., 4/0 overhead and $3,000/mi., 350 MCM cable at "normal peak loading." This evaluation will be reduced where the system pattern demands less than "normal peak loading."

even these two border-line transmission possibilities will be discarded.

V—Substation Size and Arrangement. If simple, usable concepts are to be developed, data on costs of component apparatus must be examined. Practical substation layouts and sub-assembly cost must be sought that meet the requirements external to the substation and are independent of system pattern.

Two investigations must be made: (A) The requirement of "dual voltage" subtransmission using two subtransmission voltages and "intermediate" substations to transform down, and (B) the difference in cost between 34.5- and 13.8-kv distribution substations.

Installed cost estimates of some important substation components are covered in Fig 1. They represent the averaging of estimates from several sources and will be used as the principal basis for apparatus cost comparisons. The cost data are 1942 figures increased by factors that average about 50%.

For block power transmission, transformers are large and for any given voltage the cost per kva is about constant. But for the smaller banks used in subtransmission, a more accurate figure is given by the formula:

Transformer bank cost equals

$$K + S \text{ kva}$$

where S is the incremental cost per kva and K a charge that varies with voltage.

"K" for 3-phase transformers without load-ratio control is given in Fig I. The factor "S" will be covered later. Each transformer bank carries one K charge regardless of whether fans are used or not.

Circuit breakers also have a voltage charge and a cost per kva (of interrupting capacity, IC) but this cost per kva is extremely variable. It is practically zero at 138 kv but becomes more important as voltage goes down. At 13.8 kv it dictates substation arrangement. Regardless of how big the substation or the high-side voltage, minimum cost is secured with arrangements that allow use of the metal-clad 500,000-kva, 1,200-amp, 15-kva magnetic breaker, generally as part of a unit substation.

Where power is stepped down to 34.5 kv, interrupting capacity is much less restrictive. Provision for future expansion will sometimes justify 1½ million IC regardless of initial substation size.

If reasonable economy is to be secured, the unnecessary use of high-voltage breakers must be avoided. Sometimes system patterns will allow high-voltage lines to be tapped without any high-side breakers at all. In other cases, a number of high-side breakers are necessary. Therefore, they are not included as part of the substation building block but are included in the system pattern.

Forced-air cooling is a welcome tool for "intermediate" substations. High velocity fans give continuous transformer ratings ⅔ greater than self-cooled ratings, 10,000 kva and above. With them, two 3-phase transformers can economically be used in the design of a firm-power substation building block which will fit very flexibly into most any system pattern. If 20% emergency overload is permitted, fans can be "off" except during emergency outage of one bank and yet banks can be loaded to their self-cooled rating under normal conditions. On that basis:

Transformer cost equals

$$2K - S_f \text{ kva}_f$$

where K is the voltage charge per 3-phase transformer (Fig I)

kva_f is the firm capacity of the two transformers

S_f is the incremental cost per firm kva.

High-side voltage, kv...	69	138	138
Low-side voltage, kv...	13.8	13.8	34.5
S_f	$3.00	$3.50	$3.70

(A) INTERMEDIATE SUBSTATION BUILDING BLOCKS

The system pattern will require consideration of 20, 40 and 80 Mva *firm*-power stations.

They should be arranged: (a) to drop no load during outage of either, one high-side source circuit or one main transformer and (b) so that during low-side bus faults, the emergency number of output circuits required by the 13.8 or 34.5 kv pattern will remain intact.

Normal pattern requirements are these:

Substation Size (Firm Mva)		20	40	80
No. of low-side outgoing circuits	13.8 kv	4	8	16
	34.5 kv	2	3 or 4	6 or 8

Load ratio control is not included.

Fig 2 covers the 13.8 kv low-side, 20-Mva building block. It includes unit substation equipment with 500,000 kva low-side gear. Interrupting capacity bottlenecks are avoided by using two 20 Mva building blocks for 40 Mva and four for 80 Mva.

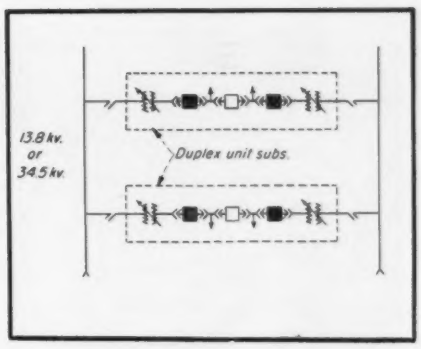


FIG 4—FOUR FEEDER distribution substation serving 5,000 kva radial load

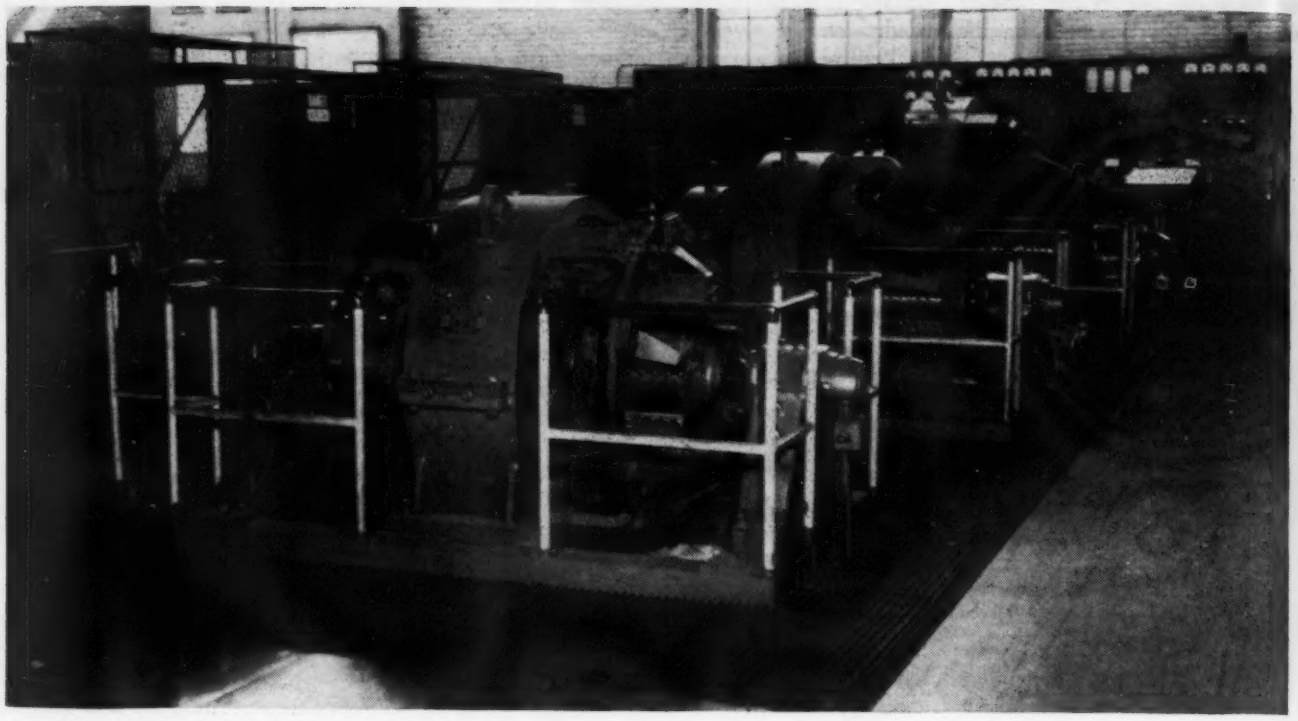
Fig 3 covers 34.5 kv low-side intermediate stations building blocks. The 80-Mva building block in this table must be used with caution in spite of the 80¢ per kva saving. The large transformers result in higher system short-circuit duty and may require larger IC breakers in the load area. Considering both IC and load growth economics, two 40-Mva building blocks will often bring better overall economy.

(B) RADIAL DISTRIBUTION SUBSTATION BUILDING BLOCK

Over a wide range of load density, distribution system savings create an overall advantage for small unattended distribution substations. For radial distribution, the "Duplex" unit substation gives both individual feeder regulation and circuit breaker transfer facilities at reasonable cost. Distribution studies have shown that the four-feeder (two duplex) substation of Fig. 4 serving 5,000 kva of load can be used to advantage over a wide range of load density.

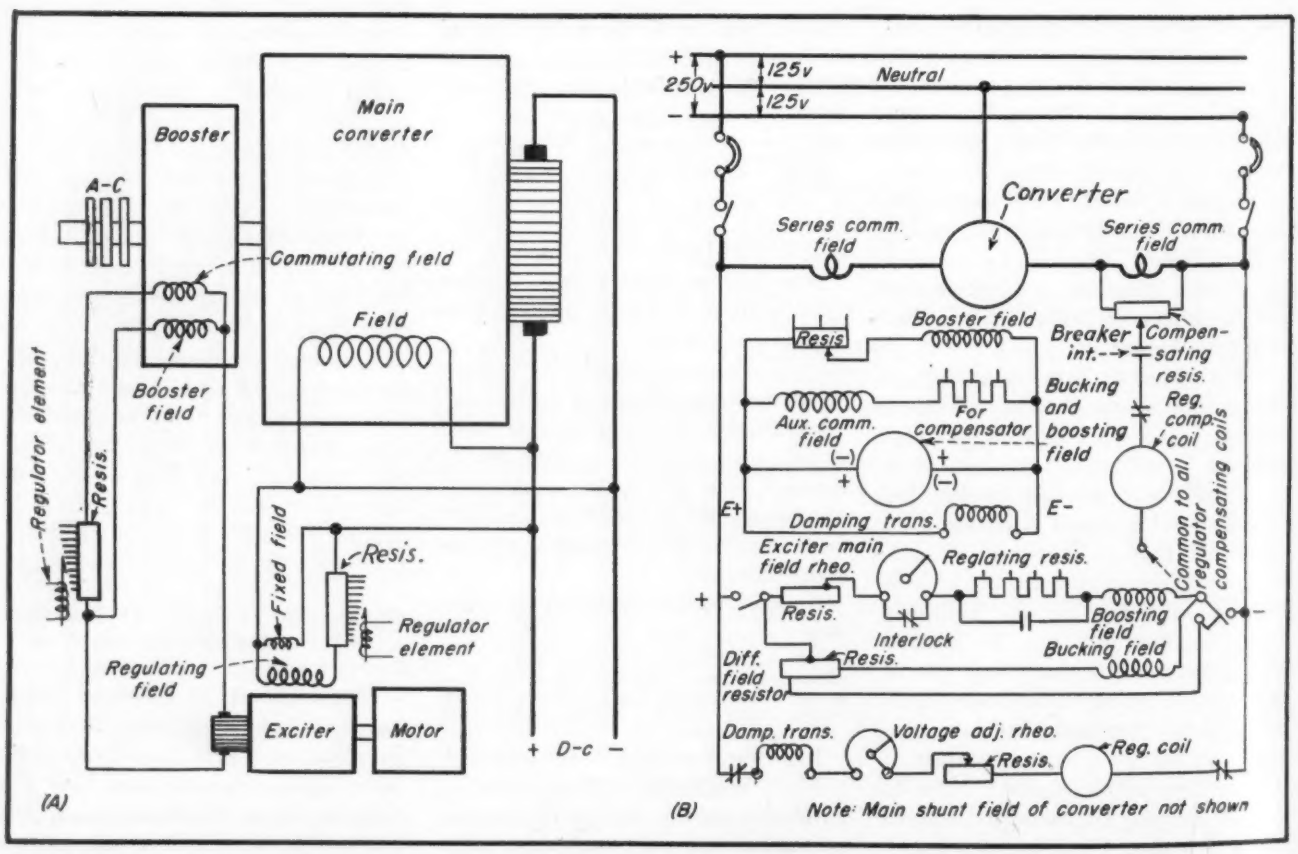
This study is confined to the relative cost of 13.8 and 34-5-kv distribution substations. With conventional open high-voltage yard, that difference need be very little more than the difference in transformer *K* charges from Fig I. $1,500 per transformer will be used here. This amounts to $\frac{4 \times \$1{,}500}{5{,}000}$ or $1.20 per kva of load.

Discussion of VI Idealized Application of Subtransmission To Radial Distribution, VII Variations with Distribution Networks and VIII The Correlation of Subtransmission and External Systems will appear in succeeding issues of ELECTRICAL WORLD.

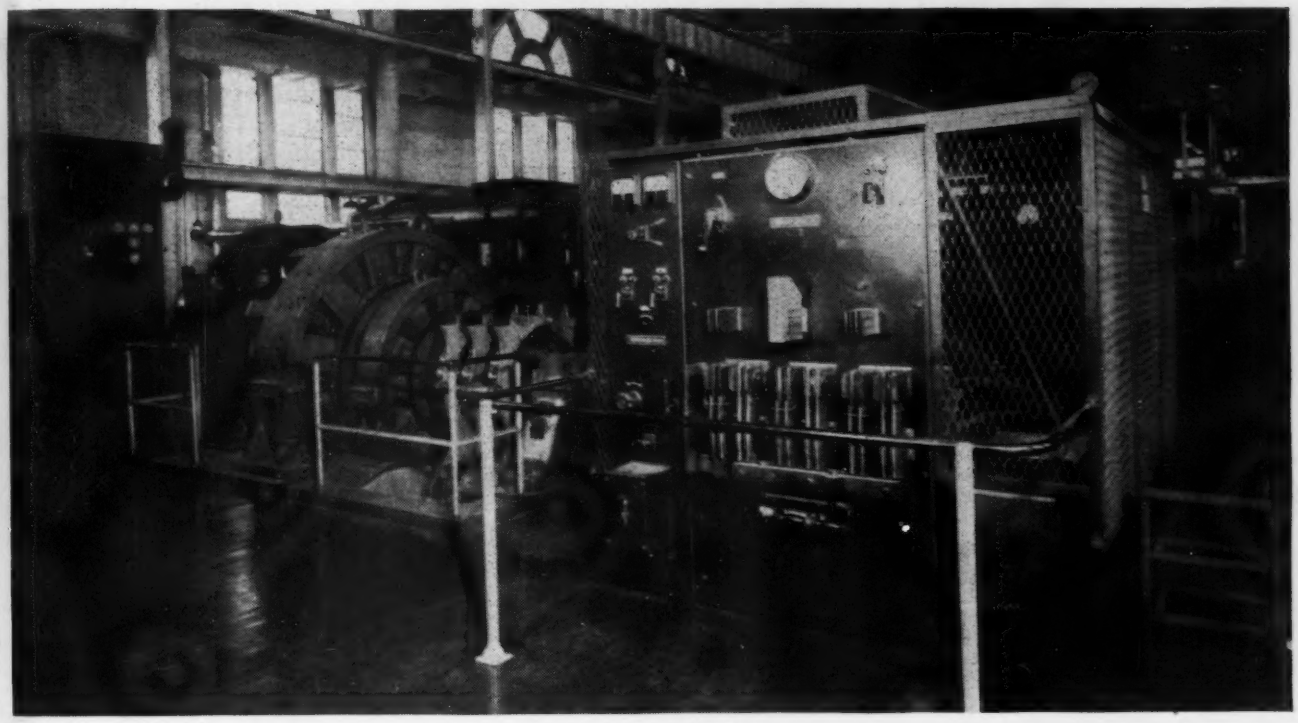


MAIN STATION has 3 units totaling 3,000 kw. 500 kw converter in foreground, 1,000 kw unit, and 1,500 kw unit

Differential Fields Control Converters



REGULATING FIELD on the exciter controls magnitude and polarity of booster field. (A) Diagrammatic relations. (B) Electrical schematic



VOLTAGE CONTROL PANEL is to left of starting panel for the 1,500 kw booster converter

Serving Large D-C Industrial Load

Magnitude and polarity on booster field of synchronous converter are both controlled by using differential field on individual exciters. Paralleled converters unaffected by a-c variations or sudden changes in d-c load

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Public Works Office
Potomac River Naval Command
Washington, D. C.

AN INTERESTING control system makes possible excellent parallel operation of seven rotary converters despite a fluctuating a-c voltage supply and heavy swings in d-c load.

The 6,000 kw of 125/250 volt 3-wire d-c power for the Naval Gun Factory, Washington, D. C., is supplied from a main generating station and substation about 1,500 ft apart. Each station has 3,000 kw installed. For normal operation the two stations are connected by three 2,000 MCM cables per leg. Thus as many of the converters as are needed can be operated in parallel. Distribution is over radial feeder circuits from each of the two stations.

The three booster-type synchronous converters in the main station consist of a 1,500-kw and a 1,000-kw and a 500-kw unit. Two are supplied by 2,400 v buses and one from a 13,200 v station bus. The four units at the substation consist of one 1,500-kw and three 500-kw booster-type converters. They are powered by 2,400 v, which is stepped-down by transformers supplied by 13,200 v feeders from the generating station.

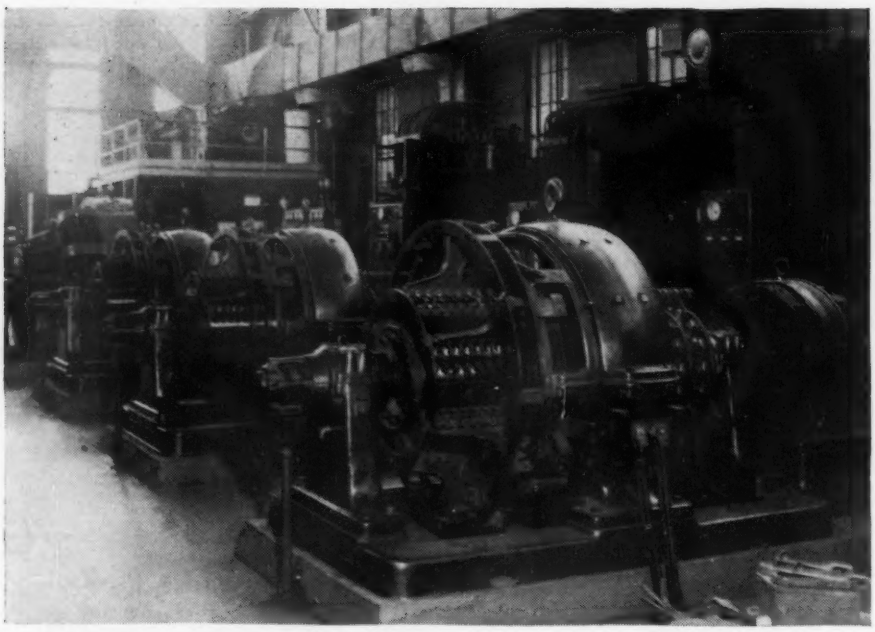
The fluctuating a-c voltage differential between the different bus sections is sometimes as much as 5%. This makes satisfactory parallel operation difficult. The operating problem is further complicated by the heavy and rapid swings in d-c loads, such as are experienced with the two 300-ton traveling cranes.

For parallel operation under these conditions, some form of automatic control is necessary. Conventional systems for controlling generator voltage cannot be applied. This is because in addition to changing the magnitude of the booster field excitation, the polarity must also be reversed to give required buck or boost in voltage.

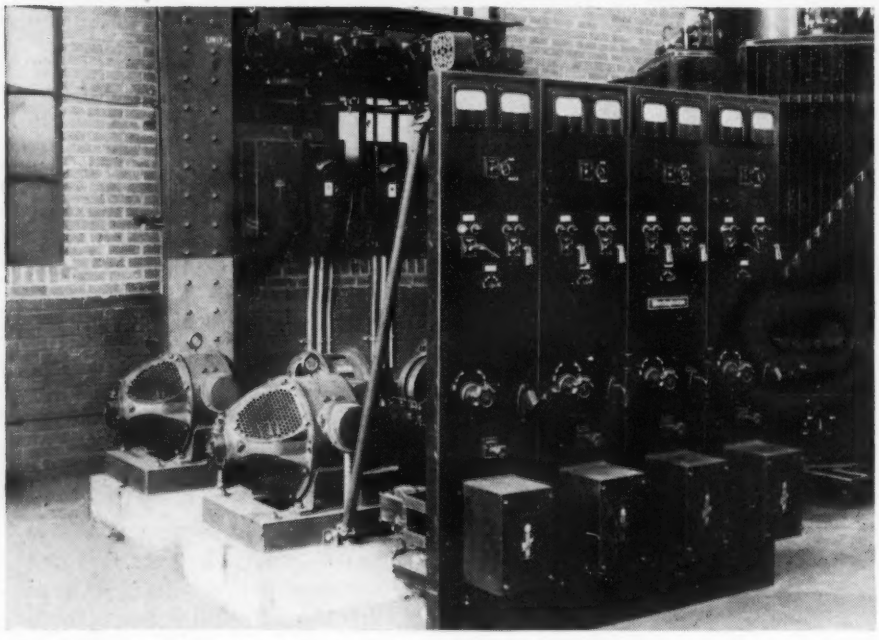
The automatic control scheme that solved the problem uses a special exciter for the booster field and a direct-acting type of voltage regulator.

Excitation for each converter booster field is from a separate

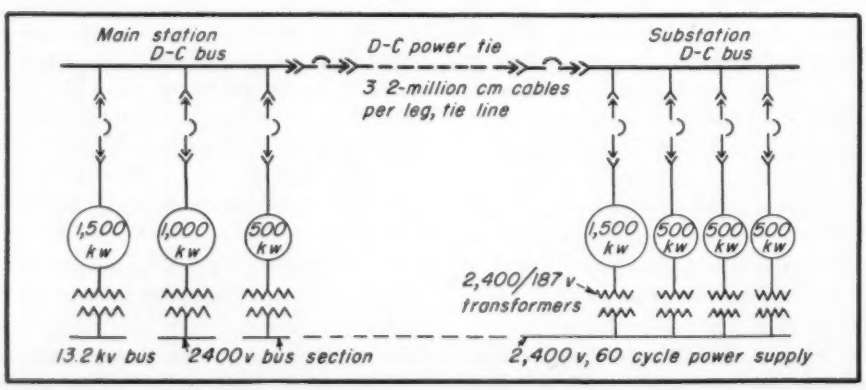
* Statements in this article are those of the author and are not to be construed as reflecting the views of the Navy Department.



SUBSTATION has 4 units totaling 3,000 kw. Three 500 kw and one 1,500 kw synchronous booster converters are shown in the above picture



THE FOUR voltage control panels and m-g sets are grouped



SEVEN BOOSTER CONVERTERS installed in two stations supply 6,000 kw 125/250 v d-c

motor-driven exciter. The exciter shunt field poles have two differentially connected coils. One field has approximately twice the ampere-turns of the other; and both energized through a field switch from the main d-c bus. One field coil is connected in series with a fixed resistance and thus supplies a constant field strength. The second coil with the greater ampere-turns is controlled by the contacts of a direct acting voltage regulator that can change the field strength over a wide range. With maximum resistance in the regulator controlled field coil, the field flux produced by the fixed field coil gives rated exicter voltage with one polarity. As the voltage regulator resistance is reduced, the opposing ampere turns of the second coil first reduce the exciter field flux to zero, and then cause it to build up in the opposite direction to give rated exciter voltage with reversed polarity. This gives a source of booster field excitation over the range of 125-0-125, which is controlled by means of a standard type voltage regulator. Also, loads between converters in one station are equalized by a load compensating winding on the operating coil of the regulator.

Winding Polarity Reversed

In a booster type converter the polarity of the auxiliary winding on the commutating poles must be reversed with each change from buck to boost. This reversal is done by an auxiliary commutating field in parallel with the booster field. The auxiliary field strength is controlled by both the exciter voltage and by a torque motor (or equivalent, such as a direct acting regulator element), connected in series with the field. This changes the field strength in proportion to the load.

At the main station, control panels are alongside the starting panels. In the substation, control panels, exciter sets, and motor operated main field rheostats are grouped. Each control panel equipment includes voltage regulator, automatic-manual control selector switch, exciter field rheostat for manual control, field switch, exciter motor control switch, d-c voltmeter, and d-c line ammeter. The d-c line circuit breakers are truck mounted, draw out type, electrically operated.

Supply for Farm Welders No Problem

Study of power supply for farm welders shows that they can be served from rural distribution system without any particular trouble from light flicker and voltage drop if transformer capacity is 3 kva or greater—Service policy results from study

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and
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INTRODUCTION of the "limited-input" or farm welder in the latter part of 1945, presented an entirely new problem for the electric utilities. It was foreseeable that this welder would have wide acceptance on the farm because it minimized to some extent the disadvantages of the industrial-type arc welder.

With upwards of 25,000 farm customers on the lines of the Ohio Power Co, we felt it was necessary to study the effect of the operation of the farm welder on our system. It was equally necessary to formulate a policy under which electric service could be made available for its use.

This study considered the problems of transformer capacity, light flicker and over-all voltage drop involved in supplying service to farm welders. In brief we found that farm welders can be served from our rural distribution system without any particular trouble providing the customer is served from a 3kva or larger transformer.

Two Years Experience

We have now had two years experience with the farm welder policy that grew out of this study. Customer acceptance has been and is excellent. Manufacturers and retail outlets selling welding equipment in our territory have extended to us their best cooperation in making it work.

A survey, made in June 1947, indicated that 600 of our farm customers are now using these welders. In serving them it was found necessary to change only 153 transformers to 3 kva or larger. Moreover, it showed us that the farm welder is handling the farmer's welding problems entirely satisfactorily.

Two things must be considered in selecting a transformer for a welder: (1) Thermal capacity and (2) voltage drop through the transformer.

The NEMA Electric Arc Welding Machine and Electrode Standards rate the farm welder at 20 percent duty cycle. This is based on a 10-minute time cycle with the welder on 2 minutes and off 8 minutes. The standards also specify 37 amp input at 230 v for the 180 amp welder power factor corrected, and 46 amp for the uncorrected welder. The input at 230 v is 8.51 kva and 10.58 kva for the 180 amp welder, corrected and uncorrected for power factor, respectively. Using 37.5 amp as the input, the welder load limit is 8.6 kva.

To determine the size of transformer required for the welder, considering the maximum input, we multiply the demand by the square root of the duty cycle expressed as a decimal. Therefore, the transformer capacity to serve an 8.6 kva welder is $\sqrt{0.2} \times 8.6 = 3.75$ kva. For the 10.58 kva uncorrected welder it is $\sqrt{0.2} \times 10.58 = 4.7$ kva.

It was concluded a 3 kva transformer would be large enough from a thermal standpoint if the input was limited to 37.5 amp at 230 v. With 46 amp, it would require a 5 kva transformer. It is still possible to overload a transformer with a power-factor-corrected welder when it is idling. This happens when the leading current taken by the capacitor in the welder is not then offset by lagging current.

In figuring voltage drop through the transformer it was assumed the welder demand would be 5 kva or less for either welder. This was proven later by tests.

Calculations of voltage drop in a 3 kva transformer were based on an IR of 2.3 percent and an IX of 2.3 percent for the transformer. Other transformer load of 1.5 kva was assumed. The welder came on with a demand of 5 kva. Power factor of the 1.5 kva load was taken as 75 percent and the welder power factor 50 percent. This gives a combined demand of 6.4 kva at 56 percent power factor. The drop through the transformer is 7.1 percent.

Overload on the 3 kva transformer was within the standards of the American Standards Association.

It was decided a 3 kva transformer was large enough for a farm welder (providing it did not require more than 37.5 amp at 230 v) from the standpoint of thermal capacity, overload ability and voltage regulation, providing the drop in the primary and secondary lines is not too great.

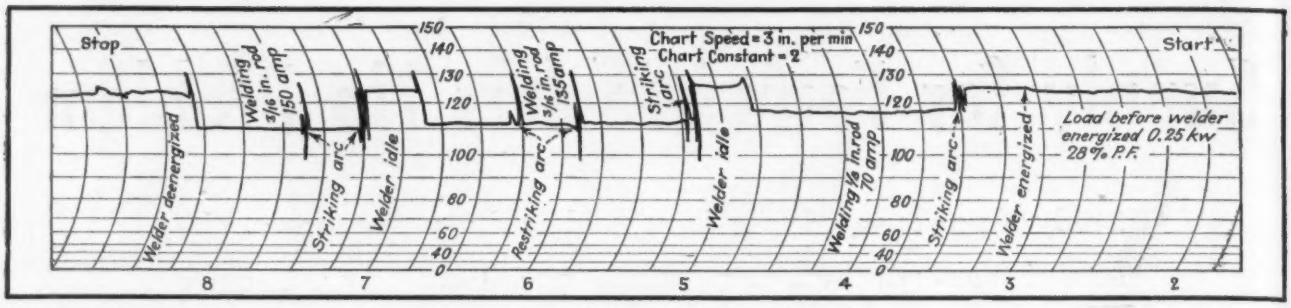
Light Flicker

Welders can and do cause light flicker due to sharp, quick changes in loads. Farm lines do not have large capacity so the question of light flicker could be a stumbling block.

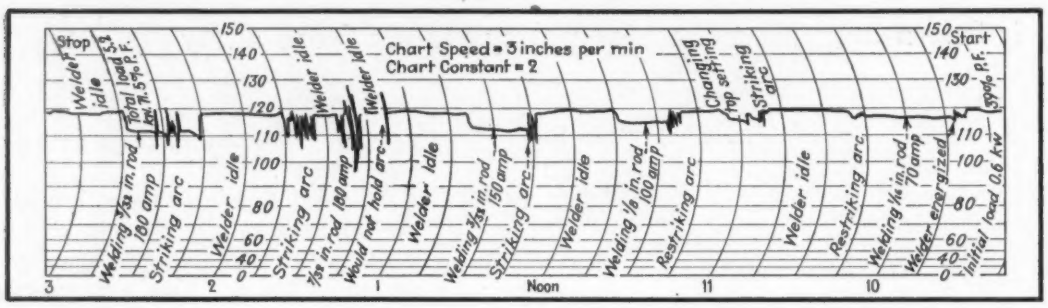
To check on flicker we assumed that the welder operator would not be expert and may strike an arc at least five times a minute. As he becomes more expert this frequency will naturally drop. We knew that we would get flicker only when the arc was struck.

A study was made on a hypotheti-

Based on a conference paper presented at the AIEE Winter Convention, Pittsburgh, Pa., January 29, 1948.



VOLTAGE CHART of limited-input welder test at Farm A. Welder, rated 20 to 150 amp uncorrected, served by 3 kva transformer



VOLTAGE CHART taken during test of limited-input welder at Farm B. Power factor corrected welder rated 20 to 180 amp served from a 5-kva transformer

cal line with the following characteristics: Length, 10 miles; conductors, No. 4 solid copper; spacing of conductors, 34 in.; voltage, 7200 volts, single-phase, multi-grounded; transformer, 3 kva; load on the line, 0 and 24.4 kva; power factor of load 75 percent; power factor of welder 50 percent; maximum demand of welder 8.6 kva.

Line calculations were made using the formula:

$\overline{E}_s = \overline{E}_r + \overline{I} \cos \theta_r + \overline{I} \times \sin \theta_r$,

which gives voltage values for one wire of the circuit only. When the line is multi-grounded, the voltage drops determined by this method are multiplied by 1.37, where line-to-line voltages are used and the line is single-phase No. 4 solid copper. They are multiplied by two when the line is single-phase delta, ungrounded.

Voltage drop through the substation transformers was not calculated because the welder demand is so small compared with the capacity of the substation that the drop would be exceedingly small and would have only a slight effect on the total drop. There may be cases where the drop in the station must be included.

Calculated drop in the hypothetical line with the 8.6 kva welder only is 0.31 percent. Flicker curves show that this voltage drop is well below the perception line of flicker. Since the flicker occurs only when the arc is struck and not during the time the arc is on, the frequency would be low and non-cyclic in character. With a frequency of five strikes per minute the line can be 35 miles long before the perceptible flicker is reached.

We need not be concerned therefore about light flicker with only one welder in operation. With more than one welder on the line, the likelihood of two more welders striking at the same time is remote. Even if two welders did strike together it would be so infrequent that the resulting flicker could be tolerated. Another factor that helps the flicker problem is that the welder will usually be operated during daylight hours when there would be the minimum chance of flicker being objectionable.

Over-All Voltage Drop

Over-all voltage drop to the welder is very important. If it is too great, poor welds will result. Electrical manufacturers usually guarantee proper operation with a ± 10 percent voltage.

Using our hypothetical line and a welder load of 5 kva with secondary and service drop one hundred and 150 ft long and No. 6 solid copper, we calculated the over-all voltage drop.

Total load on the circuits is 29.7 kva at 70 percent power factor. Voltage drop on the 7,200 v line is 1.2 percent. The load on the transformer is 6.4 kva at 56 percent power factor. This gives a drop of 7.1 percent through the transformer. Voltage drop in the secondary and service is 1.4 percent. As a result of all these drops voltage at the welder is 217.3 v and on a 230-v machine or 5.8 percent below rated voltage. The welder should operate satisfactorily. This indicates that we could have a primary line more than 10 miles long or other load greater than 24.4 kva, or both, and still be within the allowable 10 percent voltage drop to the welder.

From this study we concluded that farm welders could be served from our rural distribution system without any particular trouble provided the customer is served from a 3 kva or larger transformer adequate to handle customer's normal load.

The next problem was to formulate a policy for serving farm welders. We realized the farm welder would not be a desirable load for the company to serve as there would be little, if any, revenue resulting from their use. It was recognized, however, that the farm welder is a very important tool to the farmer and, in order to stimulate the electrification of the farm, it would probably be necessary to make it easy for the farmer to use an arc welder.

Policy

Our policy as put into effect permits the use of a farm welder having characteristics within those specified by N.E.M.A. with the further provision that it shall not draw more than 37.5 amp from the line at 230 v with power factor corrected or uncorrected. The welder must be used for the repair of the customer's own

equipment. Such a welder will be served in conjunction with the farmer's normal service account without any special charges. If the transformer does not have sufficient capacity to handle the welder it will be replaced without charge to the customer.

In establishing this policy we realized that operation of the welder might disturb the customer's own service but we did not believe this would be objectionable as it would not be for long periods nor every day.

To make farm customers familiar with the policy, a letter was sent to each farm customer stating our views and explaining the type of welder they could use on our lines. We particularly asked that they advise us when they purchased a welder so we could check the adequacy of our facilities.

Welder Tests

Tests on two farm welder installations have been made. One was a power factor corrected welder and one was uncorrected.

Farm A This farm has 20 acres. Load is served from a 3 kva transformer connected to a 12 kv, three-phase, four-wire wye system and is 1½ miles from the substation. There are 145 ft of three-wire. No. 6 secondary and a 30 ft service drop. The shop is 60 ft from the house and served by a separate circuit from the house. The connected load is as follows:

1—welder, range 20 to 150 amp, uncorrected for power factor
2—radios
1—electric refrigerator
1—1½ hp deep-well pump
1—electric washing machine
1—½ hp bench grinder
1—¾ hp air compressor
1—electric toaster
1—electric iron
1—electric range
1—600 watt bench drill
1—1.21 kw portable grinder

The test was made with different sized welding rods and current settings. Two extremes are given in Table I.

Flicker was noticed only when the arc was struck. This flicker was due to the drop in the transformer, secondaries, service drop and the 60 ft of line from the house to the shop.

If we apply the 10.8 kva demand from the table to the hypothetical line we get a drop of 0.413 percent which is well below the perception line of flicker.

TABLE I—Tests at Farm A

Type of Load	KW	Amp	Volts	KVA	PF	Welder only KVA	Welder only PF
Using 1/8 in. Rod, 70-Amp Setting							
Welder off	0.25	5.0	250	1.25	0.20	0.00	0.00
Welder energized	0.55	6.2	252	1.56	0.35	0.384	0.78
Arc struck	2.7	3.0	238	7.14	0.37	5.58	0.416
Welding	2.9	28.5	233	6.64	0.44	5.44	0.487
Using 3/16 in. Rod, 150-Amp Setting							
Arc struck	6.6	51.+	212	10.8	0.61	9.55	0.66
Welding	4.3	41.5	220.4	9.15	0.47	7.94	0.51

TABLE II—Tests at Farm B

Type of Load	KW	Amp	Volts	KVA	PF	Welder only KVA	Welder only PF
Using 1/16 in. Rod, 70-Amp Setting							
Welder off	0.6	6.5	236	1.53	0.39	0.00	0.0
Welder energized	0.8	7.6	238	1.91	0.42	0.38	0.58*
Arc struck	6.4	36.0	226	7.00	0.91	5.47	0.94
Welding	2.45	14.0	233	3.26	0.39	1.99	0.93
Using 3/32 in. Rod, 180-Amp Setting							
Arc struck	Reading Off Scale						
Welding	5.2	32.5	224	7.28	0.715	5.88	0.78

* This power factor is leading due to the welder idling with the correction on the welder.

With a welder demand of 7.99 kva we would require 3.51 kva in transformer capacity. Adding the base load of 1.25 kva to the capacity required for the welder, vectorially, we get 4.7 kva. By referring to the American Standards Association standards, we find that following 50 percent load to the transformer can take a 50 percent overload for 1½ hr.

Farm B This farm has 150 acres. The load is served from a 5 kva transformer connected to a 2.3-kv single-phase grounded line off a 4 kv, three-phase, four-wire wye system 3 miles from the substation. The farm has a load center pole. There is 75 ft of three-wire, No. 6 copper secondary to the load center pole. It is 100 ft from the load center pole to the work shop. All wiring from the load center pole is No. 6 copper. The connected load is as follows:

1—welder, range 20 to 180 amp, power factor corrected
1—electric water heater
1—electric range
1—electric mangle
1—electric washing machine
2—electric refrigerators
1—radio
1—40 cu ft deep freeze cabinet
1—40 gal ice cream cabinet
1—electric iron
1—electric toaster
1—½ hp deep well pump
1—½ hp grindstone
1—⅓ hp bench grinder
1—¼ hp bench drill
1—½ hp shaper
1—½ hp lathe
1—¼ hp air compressor
1—⅓ hack saw
1—1½ hp rip saw

The test was made with different sized welding rods and current settings. Only the two extremes are given in Table II.

With 10.9 kva demand on our hypothetical line we get a drop of 0.413 percent on the primary at 7,200 volts.

On a 2,400-v single-phase line we get a drop of 1.13 percent in 3 miles. With 5 strikes per minute we are allowed 0.95 percent drop. We would expect flicker to appear in this case. A 100-watt bulb burning in the shop showed a slight flicker which was not objectionable.

With a welder demand of 5.88 kva it will require 2.6 kva of transformer capacity. This added to the base load of 1.53 kva, vectorially, gives 3.03 kva transformer capacity required thermally. With a 5 kva transformer we had ample capacity for the welder with considerable other load.

Conclusions

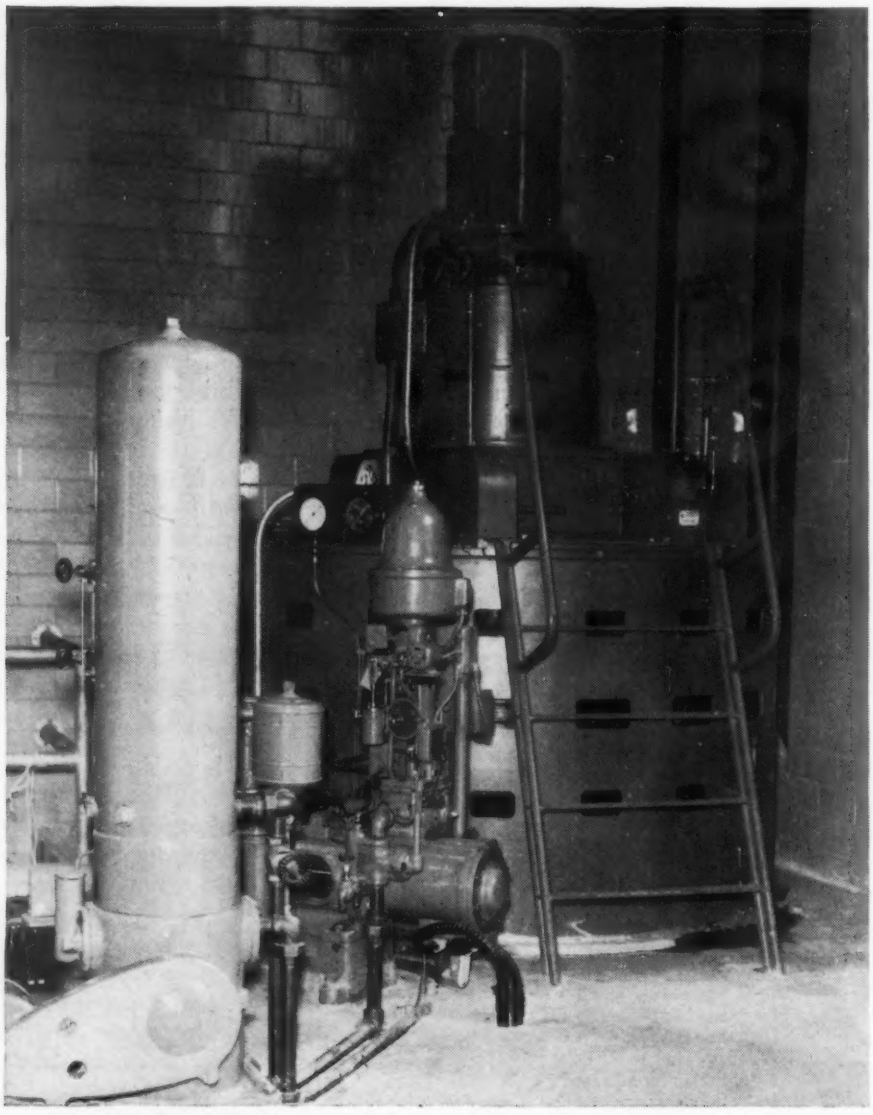
The tests made on the two welder installations have confirmed our study as to our method of serving the farm welder and verified our assumptions as to the normal welding demands of farm service.

Our farm welder policy is, in our opinion and experience, conducive to our best interest as it makes electric service available for a very undesirable load at no inconvenience to our customer, thus enabling him to make fuller use of electric service.

Develop Low-Cost By-Product Power From Municipal Water Supply

Hydroelectric development at Quabbin Reservoir delivers low cost energy to utility system from Boston water supply. Plant expected to pay for itself during next five years

LOW-COST HYDROELECTRIC POWER is an economic by-product of the latest addition to Boston's water supply facilities at Quabbin reservoir near Belchertown. The 1,500-kva development delivers energy to the New England Power Co at 22 kv on a 16-hr per day schedule. While it is small compared with the 33,000-kw development of the Western Massachusetts Electric Co at Cobble Mountain that utilizes the City of Springfield's water supply, it has points of interest.



GENERATOR, GOVERNOR and oil pump installation at Winsor Dam

The idea of developing by-product power from municipal water supplies has been successful in Massachusetts for many years. Wachusett Dam in Clinton and Sudbury Dam in Southboro illustrate this. Both are identified with the Boston water supply system. In most of the cases energy is transmitted from the generating plants to markets by the public utility companies. The amount of energy available is conditioned by water requirements of the municipalities.

Features of Hydro Plant

Quabbin Reservoir is in the valley of the Swift River, a tributary of the Connecticut, and has an area of 39 sq mi and a storage of 415 billion gal. Water is impounded by two earth dams. Winsor, the larger dam, is 2,640 ft long, reaches 170 ft above the river bed. The smaller dam is a dike 2,140 ft long and 135 ft high. Winsor Dam as a concrete core wall and 400-ft spillway. Its plant operates at about 145 ft head in connection with the outlet works of Quabbin reservoir.

Winsor plant is in an outlet structure of the dam about 900 ft downstream. Two conduits utilized as penstocks deliver water to the plant.

The water wheel is a single runner machine. At 600 rpm it delivers at least 1,680 hp under 145-ft head, 915 hp at 100 ft. Efficiency at full load and 145-ft head is 84.9%. A 6,700-ft-lb governor operates the gates under 200-psi oil pressure. An 18-in pressure regulator on the turbine is mechanically connected to the gate mechanism and operates in synchronism with the gates. It closes automatically after a load change. The maximum pressure due to full-load change does not exceed 25% above

normal, on a 2-sec governor stroke.

The generator has vertical direct-connected exciter and permanent magnet generator for driving the governor fly-balls. It is rated at 1,500 kva, 0.8 power-factor, 2,400 v and 60 cycles at 600 rpm.

Full automatic and manual control has been provided for the generating unit at the plant and duplicate control has been installed at the adjacent Administration Buildings. Normally no continuous attendance is required in the plant itself. The remote control also includes provision for operating water valves to bypass the hydro plant. Maintenance forces are available on the property in case of need at the generating plant. The usual protective features are provided in relation to starting and shutdown of the unit. In the generator-to-bus circuit is a truck type airbreaker with 50,000 kva interrupting capacity. A generator bus reactor unit of the three-phase type, air-cooled, with 1.5% reactive drop has been provided. Metal-clad switch gear was also furnished. Automatic battery charging is installed in the plant.

An outdoor substation with a 1,500-kva Erie transformer with tap changers steps up the generator bus voltage to 22 kv for interconnection with the New England Electric system.

Overall cost of the electric generating and substation facilities approximates $115,000, or about $77 per kva. This of course does not include hydraulic features outside the station, which would be essential to the water supply system apart from power generation and delivery.

Sale and Purchase of Power

In describing the Quabbin hydroelectric development before the New England Water Works Association, C. J. Ginder, senior civil engineer of the Metropolitan District Commission, Construction Division, reviewed the agreement of the State with the New England Electric System. Some of these matters are of considerable interest from the operating standpoint.

The contract can be canceled on six months notice. Primary power is purchased by the utility at 6.25 mills per kwhr during specific periods. The commission arranges the discharge of water at the station to deliver energy to the utility during the specified hours and so far as possible up to the full generating rating. Hours are set by the power company, but they must include not less than 7 hours of each Saturday. In general the company has exclusive right to take the entire output of the unit except that needed for plant and local property service. On weekdays the utility is required to take energy between 7 am and 11 pm, and other specified periods outside. The Winsor station must be operated in parallel

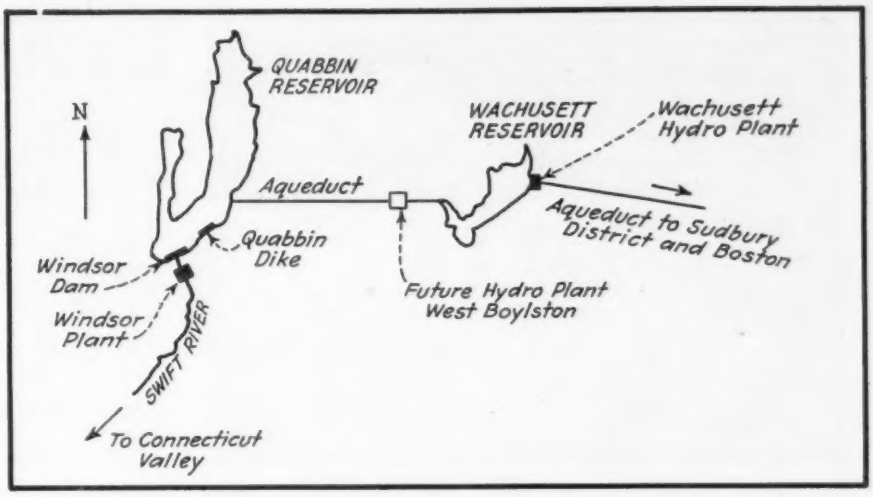


FIG 1—QUABBIN RESERVOIR hydro plant and aqueduct layout. Schematic is not to scale

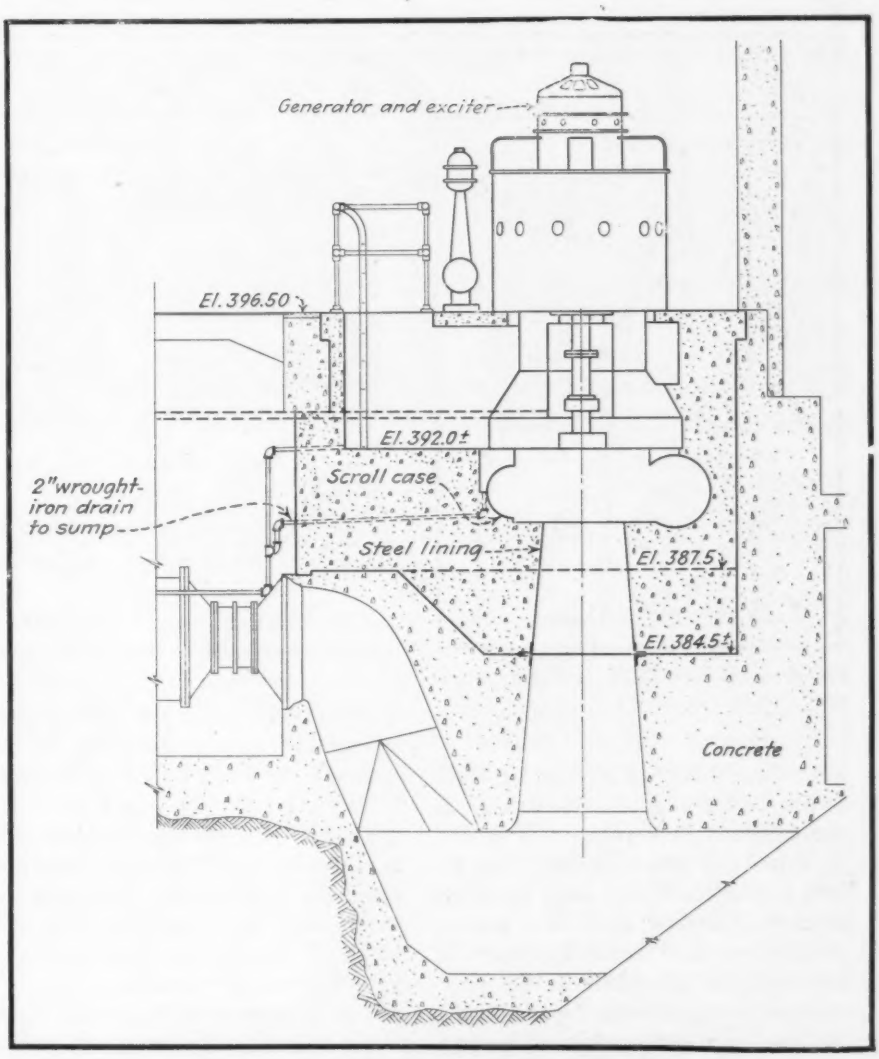


FIG 2—CROSS-SECTION of hydraulic generating unit at Winsor Station

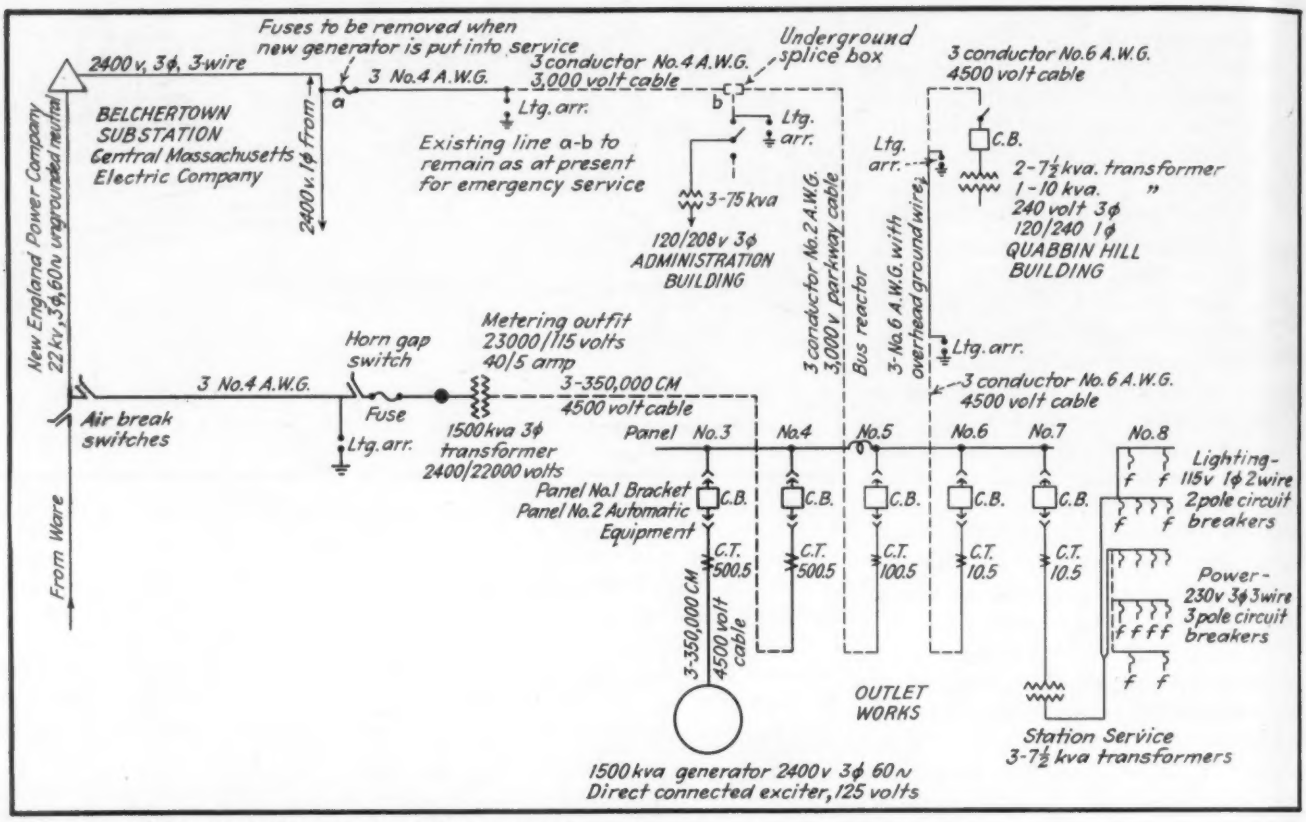

Fuses to be removed when new generator is put into service
2400 v, 3φ, 3-wire
3 No.4 A.W.G.
3 conductor No.4 A.W.G. 3,000 volt cable
Underground splice box
3 conductor No.6 A.W.G. 4500 volt cable
BELCHERTOWN SUBSTATION Central Massachusetts Electric Company
New England Power Company 22 kv, 3φ, 60 ν ungrounded neutral
2400 v. 1φ from
Ltg. arr.
Existing line a-b to remain as at present for emergency service
3-75 kva
120/208 v 3φ ADMINISTRATION BUILDING
3 conductor No.2 A.W.G. 3,000 v parkway cable
Bus reactor
3-No.6 A.W.G. with overhead ground wire
C.B.
2-7½ kva. transformer
1-10 kva. "
240 volt 3φ
120/240 1φ
QUABBIN HILL BUILDING
Horn gap switch
Metering outfit 23000/115 volts 40/5 amp
3-350,000 CM 4500 volt cable
Air break switches
Fuse
1500 kva 3φ transformer 2400/22000 volts
From Ware
Panel No.3
No.4
No.5
No.6
No.7
No.8
Panel No.1 Bracket
Panel No.2 Automatic Equipment
C.T. 500.5
C.T. 100.5
C.T. 10.5
Lighting- 115 v 1φ 2 wire 2 pole circuit breakers
Power- 230 v 3φ 3 wire 3 pole circuit breakers
3-350,000 CM 4500 volt cable
OUTLET WORKS
Station Service 3-7½ kva transformers
1500 kva generator 2400 v 3φ 60 ν
Direct connected exciter, 125 volts

FIG 3—STATION CONNECTIONS AT WINSOR PLANT showing tie into New England Electric System

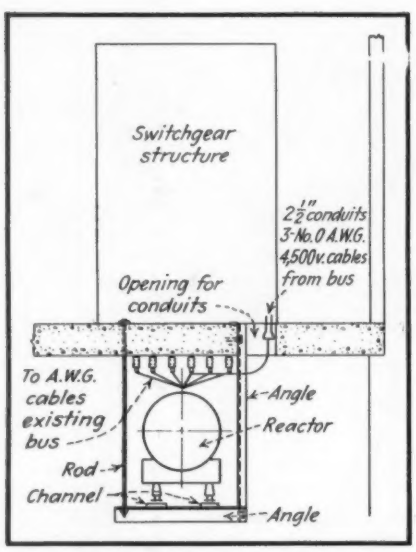


FIG 4—BUS REACTOR is below switchgear structure in plant

Cost of 1,500-Kva Hydro Plant at Winsor Dam, Belchertown, Mass.
(Excluding exterior hydraulic facilities)

Equipment	
Water wheel; 1,700 hp, vertical	$27,953
Generator, 1,500 kva, 2,400-v, 60-cycle	17,192
Switchgear	10,403
Bus Reactor	450
Metering Outfit (at substation)	803
Control panel	554
Substation Structure, Fittings, etc	1,833
Transformer, 3-phase, 1,500 kva., 2.4 to 22 kv	4,299
Storage Battery and Charging Equipment	965
Total	$64,452
Installation Costs	
Waterwheel, Governor, etc	$4,900
Generator, Exciter, etc	3,100
Switchgear, controls, etc	1,500
Erecting Outdoor Substation	2,000
Furnishing and Erecting 22-kv. line, 3-phase, 800 ft. to tap	3,000
Conduits, wiring, etc	15,750
Cement, steel, concrete, etc	8,948
Total	$39,198
Combined Total	$103,650
Grand Total with allowance for engineering, contingencies, etc	$115,000

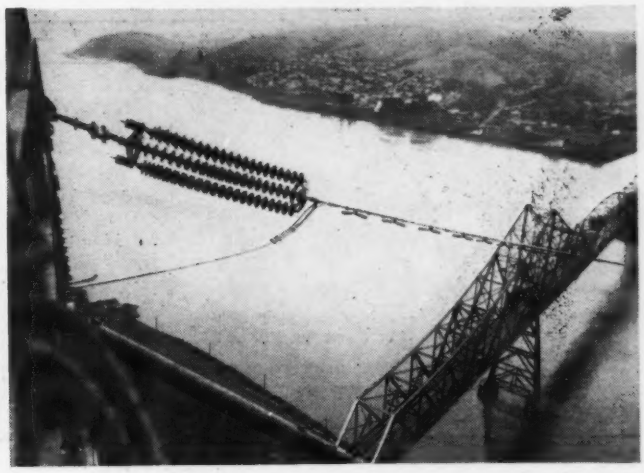
with the NEES, at not under 80% power factor and at such voltage as the company may reasonably desire.

Although it is not an obligation, intent is that the utility shall purchase energy generated at Winsor station outside specified hours if it can be economically absorbed in the company's system at the Commission's prices. When the plant is not in operation, the Commission may take not over 100 kw from the utility. The voltage of energy delivered to the utility is not to vary more than 10%.

The price for secondary power is not set in the contract. The Commission's estimates of revenue from the plant are based on the assumption of being able to receive 3 mills per kwhr. Prices paid by the power company for energy are subject to review by the Massachusetts commission. Yield of the Quabbin reservoir system will exceed the water needed for supply purposes for many years. The average yield of the Quabbin reservoir is about 195 million gallons per day (mgd). After the demand for water increases to a point where substantial reductions in power releases to the Swift River (from 137 mgd in 1947 to 44 mgd in 1968) the plant will still bring a satisfactory profit to the state.

It is estimated that the Winsor station will pay for itself during the next five years.

SPECIAL CATWALK extending 50 ft along the conductor to allow for installation of 35-ft armor rods beyond the 15-ft dead-end assembly. Designed to support eight men and 500 lbs of tools, it will be used for necessary maintenance work



DEAD-END ASSEMBLY showing the vibration dampers and six strings of 20 insulators. Armor rod and conventional Stockbridge dampers are supplemented by parallel conductors of the same material as the main conductor (Electrical World, Feb 14, 1948)

Radio Speeds Sagging of Long Span

TWO WAY RADIO cut an estimated 20% from the time required to lay and sag-in conductors in the 4,805 ft span over Carquinez Strait, near San Francisco. The span of six 804,500 cir mil ACSR conductors between 383-ft towers is the final link in a new $3,000,000 line of the Pacific Gas and Electric Co to bring 220 kv into the San Francisco area for the first time.

Previous use of two-way radio by PG&E for sagging in transmission conductors (Electrical World, Jan. 31, 1948, p 60) contributed to their efficient use on the Carquinez Strait span.

PORTABLE RADIO-TELEPHONES being used by the Pacific Gas and Electric Co to guide the laying and sagging of six 4,805-ft conductors over Carquinez Strait, near San Francisco. Sets were located at each tower, at a rail and highway crossing, near two tractors which supplied power for sagging-in, and on two launches which controlled water traffic and observed the conductor as it emerged from the water

Six Radio Telephones Used

Six portable receiver-transmitter sets were used to coordinate the operation and insure maximum protection of the conductors with minimum interference from rail, highway and water traffic. Three were in pick-up trucks—one near the south tower at the sag-controlling transits, one at the rail and highway crossings and one at the disposal of the foreman in charge, who was generally at a spot from which all operations could be observed. A fourth set, installed in a line truck, was stationed near two RD-6 Caterpillar tractors, which in tandem furnished power for sagging the conductors. This line truck was also connected by wire telephone to a man in charge of operations at the top of the north tower, where the conductor was secured and the installation completed. Two other sets were installed temporarily in motor launches to report on the progress and condition of the conductor as it emerged from the water, and to dispatch other launches up and down stream to intercept water traffic when necessary. A spare set was provided for emergencies, but generally used so spectators could follow progress of the work.

Since the span crossed a railroad and highway right of way and a 22-kv power line, and because of heavy water traffic and swift currents in the strait, it was decided to complete the installation without lowering the 7,618-lb conductors after checking them for length. A special platform or catwalk was built to extend along the conductor 50 ft out from the tower face to allow installation of the 35-ft armor rods and damping devices. As shown, slope of the platform was adjusted by triple sheave blocks reeved with $\frac{3}{8}$-in steel cable. Side sway was controlled by a horizontal 4-in pipe stiff leg.

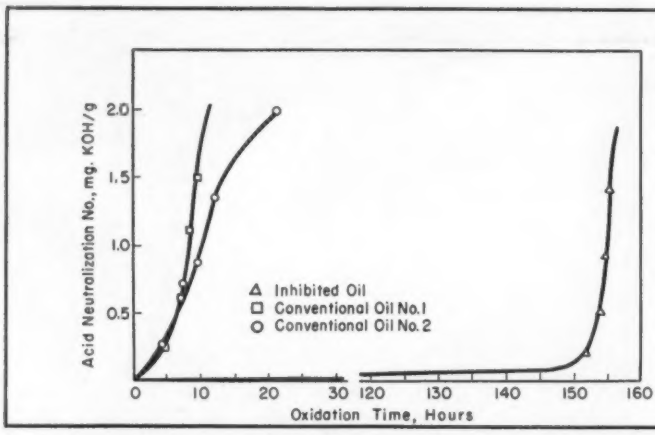


FIG 1—**INCREASE IN ACIDITY** with time for two conventional uninhibited oils and one inhibited oil

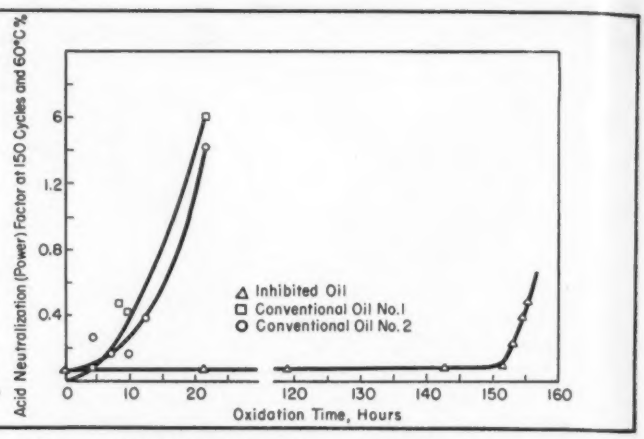


FIG 2—**INCREASE IN POWER FACTOR** with time for two conventional uninhibited oils and one inhibited oil

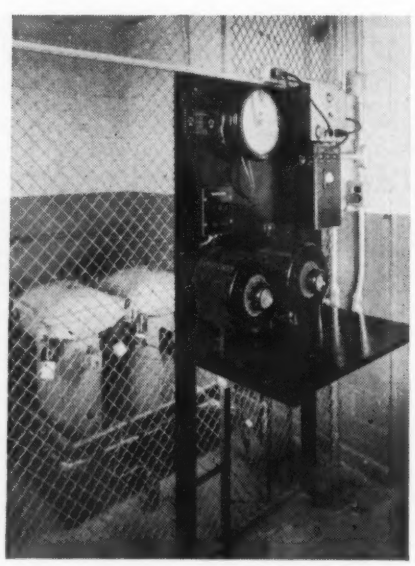
Inhibited Insulating Oil Promises Longer Life

Use of inhibitors produces transformer oils of good characteristics that may increase useful life three to five times

R. G. LARSEN and T. E. REAMER
Shell Development Co
Emeryville, Calif.

SINCE the introduction of inhibited turbine oils a few years ago, a great deal of research has been devoted to producing an electrical insulating oil with similar improved non-oxidizing, non-sludging and other pertinent characteristics. Out of this research has come a new inhibited insulating oil. Results obtained in accelerated laboratory tests and confirmed by temperature runs in commercial transformers indicate that this inhibited insulating oil will give longer trouble-free service than conventional uninhibited oils. It is predicted that, under similar operating conditions, the useful life will be increased three- to five-fold.

Mineral insulating oil plays an important part in the electrical industry. Core and coils of most transformers and the operating mechanism of many circuit interrupting devices are immersed in a dielectric oil. This not only acts as an electrical insulator, but also removes the heat arising from energy losses. Selection and refining of a mineral oil to fulfill these requirements initially is not difficult. However, deterioration of the oil in service through oxidation, with the concomitant formation of sludge and other oxidation products, may soon impair its useful function seriously. Sludge deposits impede cooling by the oil, acids promote emulsification of water in the oil and thus contribute to lowered dielectric strength, while peroxides seriously weaken fabric insulation.



TEST SET-UP for evaluation of inhibited and conventional uninhibited transformer oil in full-size transformers. Top oil temperature thermostatically controlled at 90 deg C. Entire heat input supplied by energy losses from windings and laminations

Deterioration of electrical oils may be prevented or hindered by the addition of a suitable antioxidant to a properly-refined base stock. This base must be chosen with care. Over-refined oils of the B.S.I. A-30 type, although very responsive to antioxidants, tend to oxidize too rapidly after depletion of the additive. Use of a less refined oil, that would give satisfactory performance even without additives, is more satisfactory. Furthermore, the antioxidant must be non-acidic and not impair essential oil properties such as thermal conductivity, dielectric strength, and power factor.

Laboratory determination of the stability of transformer oils cannot be relied upon to predict accurately the life of an oil in service, since environmental conditions are not precisely duplicated. However, an accelerated test method has been de-

vised, in these laboratories, which is useful in evaluating the relative stabilities of inhibited and uninhibited oils through continuous determination of the oxidation rate. The test is normally terminated at a degree of detrioration corresponding to that reached in service.

The rate of oxidation of an inhibited transformer oil in the Shell Development accelerated oxidation test is compared with two conventional uninhibited oils (Fig. 1.) Whereas the latter oxidize at once, the inhibited oil absorbs very little oxygen during the induction period. Hence, the development of acidity and the increase in power factor (Fig. 2) is correspondingly low. However, oxidation proceeds after termination of the induction period at the same rate as for the uninhibited oil since true antioxidants do not alter the oxidation rate when depleted. It may also be shown that the decrease in interfacial tension and in resistivity of the inhibited oil is retarded during the active life of the antioxidant as are power factor and acidity.

Stager first noted that peroxides present in oxidized oil attack cellulose with the formation of friable oxycellulose. Since the insulation on the coils of transformers contains cellulose, its deterioration with a consequent possible drop in electrical insulation resistance is important. To illustrate this effect, two oils were subjected to similar oxidizing conditions. The uninhibited oil after aging showed an acid number of 1.4 milligram of potassium hydroxide per gram (mg KOH/g) and a peroxide number of 5.3 milli-equivalent per liter, whereas the uninhibited oil treated exactly in the same manner was free of acids and peroxides. Lengths of pre-dried cotton thread were immersed in each of the oils at 100 deg C for 6 days. Tensile strength measurements showed that the thread from the oxidized uninhibited oil had dropped from an initial breaking strength of 3,400 g to 1,500 g but the breaking strength of the thread from the inhibited oil decreased only from 3,400 g to 3,200 g. Similar experiments with paper used in transformer construction showed that peroxides did not weaken it.

Evaluation of oils in full-scale transformers offers more convincing evidence of oil stability than any small-scale laboratory procedure. Hence, two 5-kva pole-type transformers were coupled in opposition as shown, in a manner recommended by the American Standards Assn. for temperature tests. Normal voltages were present in the windings, but the current was maintained at 175 to 200% of rated capacity which resulted in a continuous top oil temperature of 90 deg C. One unit contained a conventional uninhibited oil while the second unit was filled with an inhibited transformer oil. Air was freely admitted to both transformers and the testing was continued for a period of one year. This is approximately equivalent to 10 years' normal operation. At intervals samples of both oils were withdrawn and transformer temperatures at various points were recorded.

As indicated in Fig 3 and Table 1, the acidity of the uninhibited oil gradually increased with time until a value of 0.5 mg KOH/g was reached after one year, and concurrently 0.13%w of sludge was formed. Inspection of the core at the conclusion of the test revealed considerable sludge adhering to the windings and laminations. Although the net amount of sludge was relatively small, sufficient was present to increase both the copper and iron temperature during the run (Table 1). Coil temperature

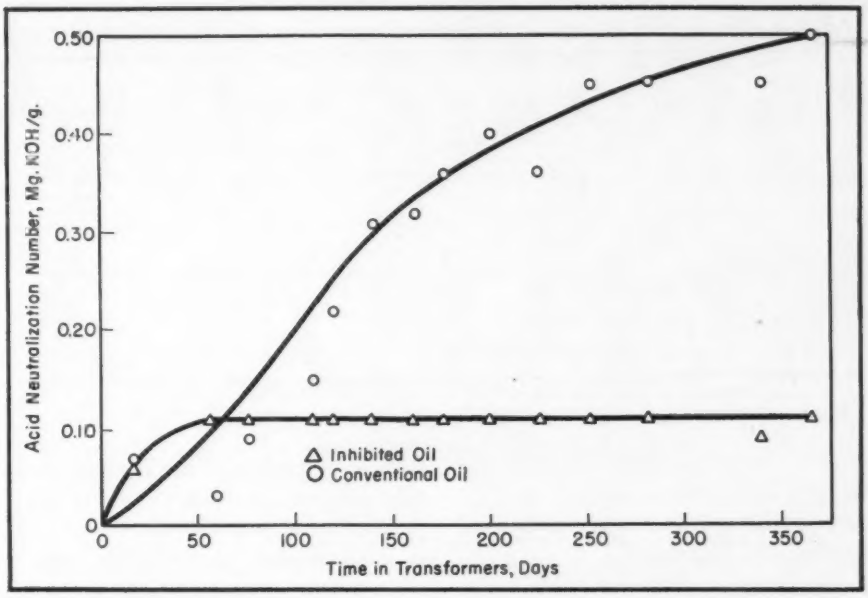


FIG 3—INCREASE IN ACIDITY with time for inhibited oil and conventional uninhibited oil during temperature run on two 5-kva pole-type transformers open to the air

TABLE I—Temperature and analytical data on inhibited and conventional uninhibited oils from test transformers

Time in Transformer, days	Inhibited Oil						Uninhibited, Conventional Oil					
	Top Oil Temperature, °C	Copper Coil Temperature, °C	Iron Temperature, °C	Acid Neutralization No., mg. KOH/g.	Color (Union)	Sludge, % (ASTM D670-42T)	Top Oil Temperature, °C	Copper Coil Temperature, °C	Iron Temperature, °C	Acid Neutralization No., mg. KOH/g.	Color (Union)	Sludge % (ASTM D670-42T)
0	76	82	78	0.00	1	0.00	74	85	79	0.00	1	0.00
18	75	81	79	0.06	1	....	74	84	79	0.07	1½	....
64*	91	96	93	....	....	....	88	101	93	....	....	....
77	91	97	93	0.11	1½	....	88	101	93	0.06	3	....
108	93	99	95	0.11	2	0.00	90	105	97	0.15	3	0.03
140	93	99	96	0.11	2	....	91	105	98	0.31	3½	....
161	92	97	94	0.11	2½	0.00	91	105	98	0.32	4	0.03
200	90	97	97	0.11	2½	0.01	90	107	97	0.40	4½	....
226	91	97	97	0.11	2½	....	91	106	98	0.36	4½	....
253	90	96	96	0.11	2½	....	91	107	99	0.45	5	....
281	90	96	96	0.11	2½	....	90	109	100	0.45	5	....
281	91	97	96	....	....	....	91	108	100	....	....	....
317	91	97	97	0.09	2½	0.01	92	111	102	0.45	5	0.05
339	91	97	97	0.11	3	0.06	92	111	102	0.50	6	0.13
365**												

* Temperature increased to accelerate deterioration.
** Final samples contain full amount of sludge.

TABLE II—Typical tests on several inhibited and conventional uninhibited transformer oils

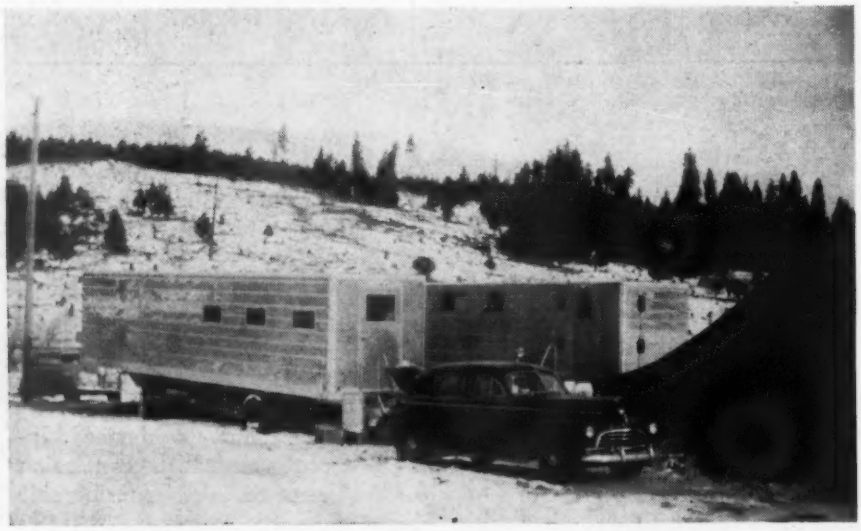
Oil Designation	Specific Gravity 20/4°C	Viscosity S.S.U. at 210°F	Pour Point, °F	Sulfur, %w	Oxidation Tests		
					Snyder Life,+ days	ASTM Sludge Accumulation Test (Sludge content after 2 weeks) %++	Shell Accelerated oxidation. (650-ml. O_2/100 g. oil absorption time, hr.)
Conventional Oil No. 1..	0.8662	57.2	−40	0.17	27	0.49	6.6
Conventional Oil No. 2..	0.8966	61.0	−65	0.06	40	0.65	7.0
Conventional Oil No. 3..	0.8699	58.8	−70	0.09	27	0.31	7.0
Conventional Oil No. 4..	0.8634	52.9	−65	0.07	27	0.20	9.3
Conventional Oil No. 5..	0.8780	55.5	−70	0.08	50	0.25	14.0
Conventional Oil No. 6..	0.8777	56.2	−70	0.09	50	0.43	14.3
Inhibited Oil.....	0.8665	60.1	−60	0.02	160	0.00	168.0

+ Snyder, ASTM Proc. I, 23, 448 (1923).
++ ASTM Method D670-42T, A.

after 64 days operation was 101 deg C. and after 365 days 111 deg C; corresponding iron temperatures were 93 deg and 102 deg C.

Comparable data for the transformer containing the inhibited oil indicated a rise in acidity to 0.1 mg KOH/g during the first 77 days of operation but no further increase during the remainder of the test period. The slight acid value is caused by solution of acidic varnish components in the oil and is not the result of oil oxidation. A similar effect has been noted by others in transformers sealed with an inert gas. Thus, Horsch reports an acid value of 0.15 mg KOH/g after 3 years of operation at 85 deg C under nitrogen. The dissolved varnish also appeared as a pseudo-sludge upon cooling the inhibited oil at the conclusion of the test. Unlike the transformer containing the uninhibited oil, only negligible increases in copper and iron temperatures were noted in the inhibited oil during the entire test period. These data offer convincing evidence that no true oxidation of inhibited oil occurred during the test.

Full-scale tests of similar nature were recently completed by large electric utilities on the above inhibited oil and several miscellaneous conventional oils. In one case the inhibited oil was still imperceptibly oxidized and only slightly discolored, after a test period of nearly a year at an over-all oil temperature of 100 deg C, while the uninhibited oils showed acid numbers ranging up to 2.0 and heavy sludge deposits. Moreover, insulation resistance of the 15-kva unit containing the inhibited oil was unchanged, while the resistance of the transformers containing conventional oils had decreased 65% to 100% (i.e., they had failed).



TRAILER LIVING QUARTERS for linemen on rural construction solved a union labor problem and at the same time eliminated three-hour crew traveling time per day. Clearwater Valley Light and Power Association (REA) of Lewiston, Idaho, expects a net saving of $45,000 per year by use of the units. Bunk house and cook house are both equipped with gas furnace, gas hot water heaters and 3,000-watt automatic a-c generators. The two units accommodate 16 men

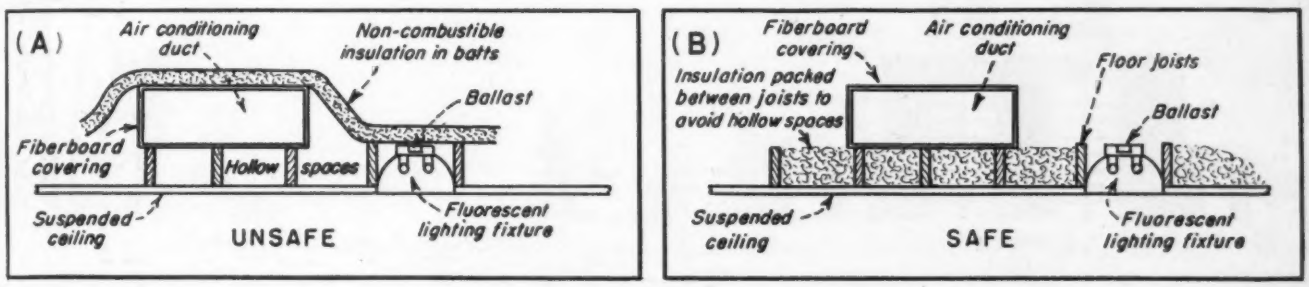
Effect of Filtering and Reclaiming

Full advantage of an inhibited oil can only be attained if the oil is used in a new or well-reconditioned transformer. However, since the oil may be used to top-off existing units or may be mixed with new conventional oil, the effect of blending must be considered. A large number of experiments have indicated that the direct blending of a new conventional oil with an inhibited oil results in the lowering of the stability of the more oxidation resistant component. The decrease in stability of the inhibited oil is not always in direct proportion to the amount of uninhibited oil present, since the response or susceptibility of the latter to antioxidants is seldom as great as for the inhibited base oil. In no case is the stability of the blend less than that of the least stable component.

Blending of adequately processed reclaimed oils with an inhibited oil follows much the same pattern as with new uninhibited oils. Blending with oxidized oils, however, greatly lowers the stability of the inhibited component so that most of the beneficial effect of the inhibitor is lost. Caution should be taken in reconditioning transformers to assure the complete removal of all oxidized oil before the addition of an inhibited oil. However, the presence of dry oil-free sludge has no deleterious influence on inhibited oil stability. In one series of extended tests it was noted that the stability of an inhibited oil in a reconditioned transformer was greater than the stability of the same oil in a new transformer. In our experience, the blending of two or more inhibited oils does not result in any precipitation or discoloration of the blend, while the stability falls between those of the most stable and the least stable components.

Fullers earth and similar clays used in reclaiming procedures remove the end products of oxidation but apparently do not eliminate some of the prooxidant intermediate products as most reclaimed oils oxidize more rapidly than the original oil. Since conventional reclaiming procedures tend to remove inhibitors it is beneficial to delay processing of inhibited oils until the antioxidant is exhausted.

HOW TO DESIGN • CONSTRUCT OPERATE • MAINTAIN



UNSAFE AND SAFE methods of fluorescent lamp installation. Batts had asphalt-impregnated paper which ignited when ballast failed

Avoid Fire Hazards of Fluorescent Lighting Installations

THE GENERAL FIRE RECORD of fluorescent lamps has been good. But care is needed in installations.

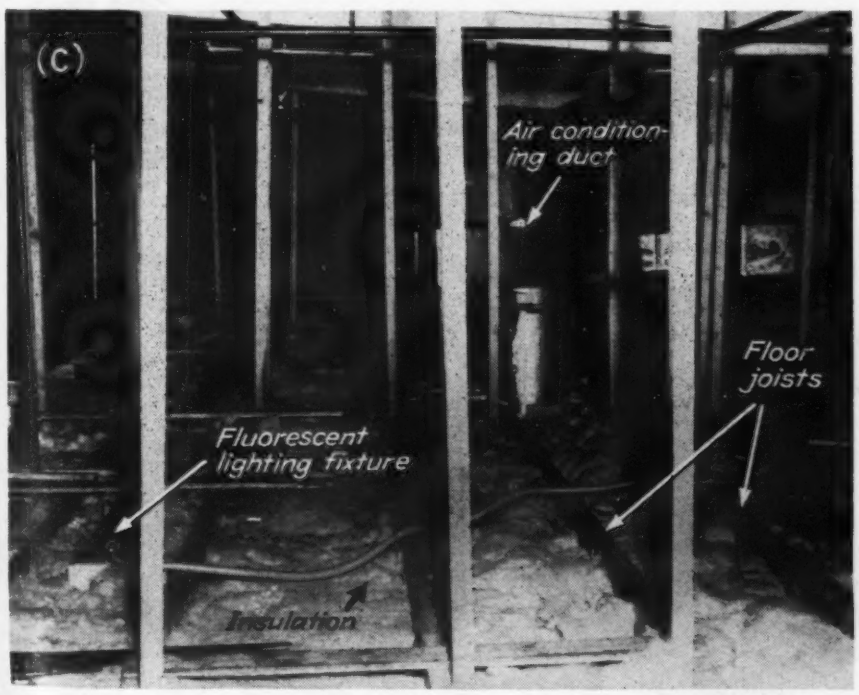
Standard approved installations of recessed fixtures, as defined by the National Electric Code, specify a minimum clearance of 0.5 in. between the fixture and combustible materials, except at support points. The ballast location is also important. A safe practice is to place the ballast away from contact with the fixture top. Wiring inside the fixture should have asbestos-covered insulation.

The Associated Factory Mutual Fire Insurance Companies, Boston, Mass. reports that most of the fires in fluorescent lamps are caused by electrical failure of the ballasts in hot cathode units. Normally the ballast preheats the cathode filament, supplies the inductive impulse required to light the lamp, and limits the current of the lamp while operating. When failure occurs, the ballast can overheat enough to ignite combustible insulation or other material without producing sufficient fault current to operate the protective device.

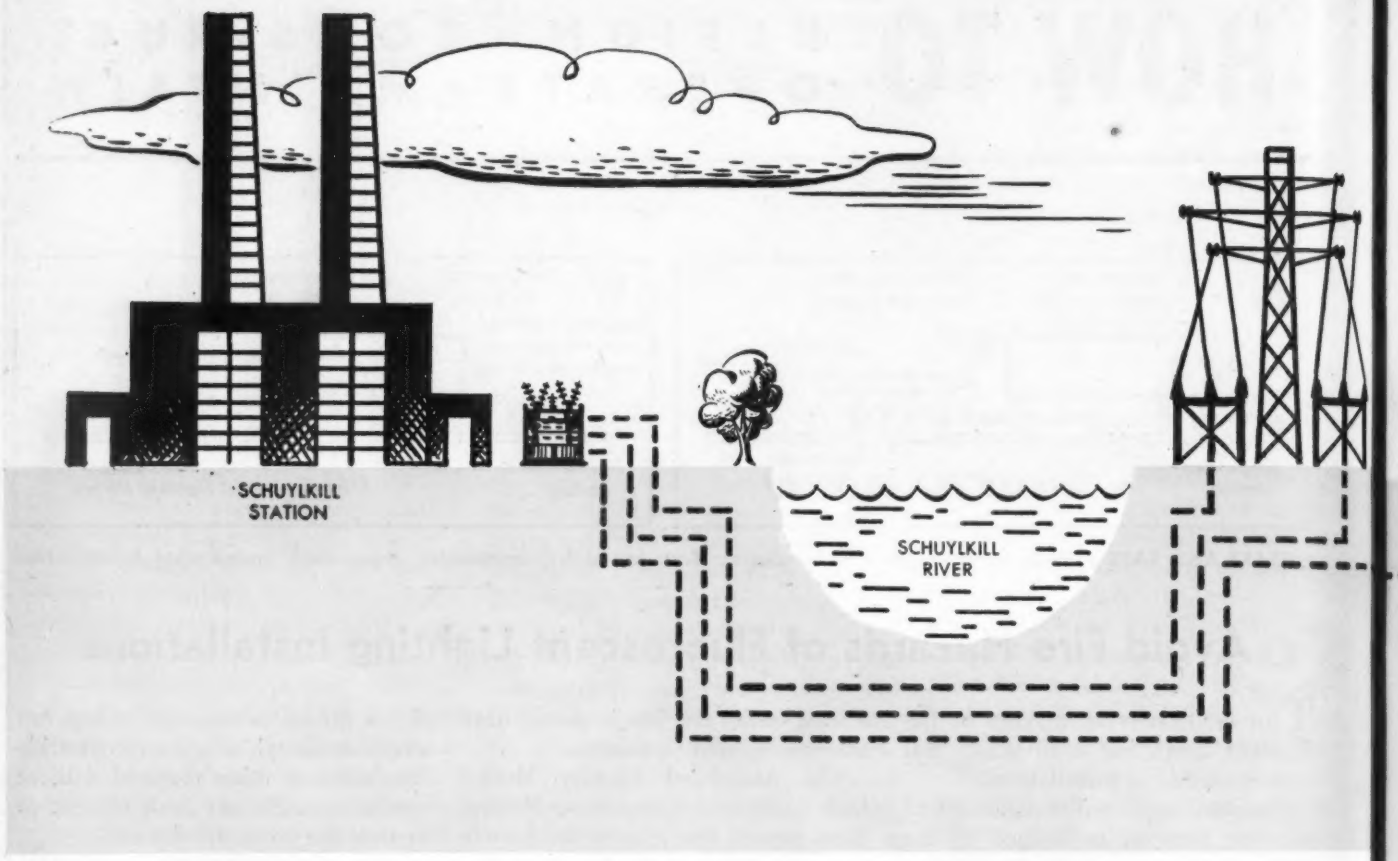
A loose contact in a lamp holder at the end of a fluorescent tube is another source of fire. A loosely fitting tube can lead to formation of a slight arc which may increase as the bakelite tip of the tube becomes carbonized. Combustible insulation on wiring can thus be ignited. The metal tips on the newer lamp tubes are not subject to this difficulty.

The care that must be taken in installing fluorescent lamps is illustrated by the following case. An office in an upper story of a manufacturing building, had just been remodeled and air-conditioned. Recessed lighting fixtures of the hot cathode type were installed between joists in a suspended ceiling. Insulating batts of non-combustible material were laid loosely across the top of the joists, resting directly on the lighting fixtures. As a result, the asphalt impregnated paper which covered the batts was in contact with the fixtures. Concealed spaces were formed between the joists where fire could burn out of reach of water from sprinklers.

An electrical breakdown of a ballast unit on top of a fixture led to overheating and ignition of the paper. The flames spread along the paper, set fire to the joists of the false ceil-



IMPROVED INSTALLATION of insulation between joists. No insulation was placed on top of the flourescent lighting fixtures. Concealed spaces between joists were eliminated



Philadelphia Electric

with GE

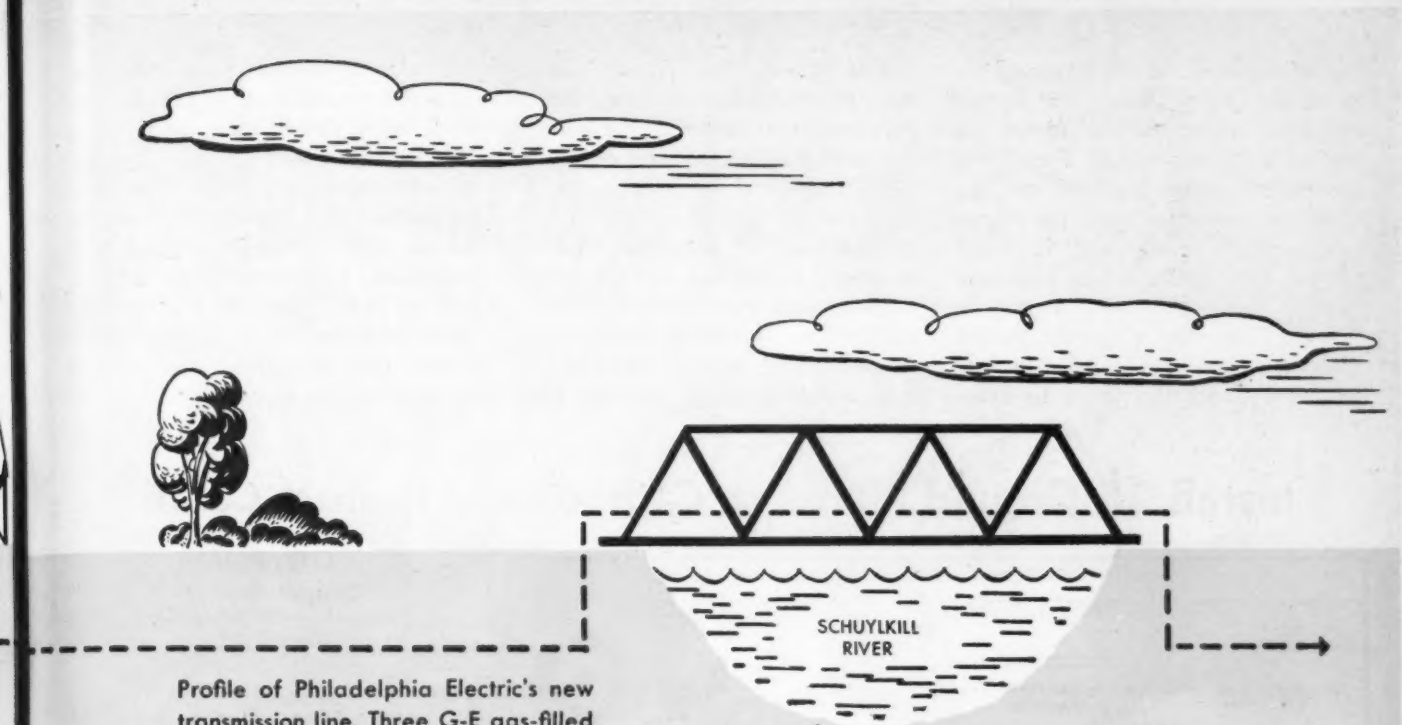
minimizes profile problems

no pumps

no large tanks

self-supervising

lower maintenance



Profile of Philadelphia Electric's new transmission line. Three G-E gas-filled pipe cables now help link Schuylkill with various substations. Note sharp variations in elevation.

Found a Simpler Way!

GAS-FILLED PIPE CABLE

One of Philadelphia Electric's problems in planning for additional capacity was the selection of transmission lines.

Overhead wires and oil-pipe systems had to be ruled out in certain areas.

For those lines involving severe profile conditions, the engineers, working with General Electric, decided to use gas-filled pipe cable. Not only has it eliminated the problems of a varying profile, but it gives Philadelphia Electric a simpler system as well.

Gas-filled pipe cable eliminates many of the accessories that oil-pipe systems require, and also promises lower maintenance costs because it's more self-supervising.

When you need a high-voltage cable, General Electric engineers can help you select the right type for the job. G.E. offers engineering, manufacturing, and installation experience with all types of high-voltage systems. *Apparatus Dept., General Electric Company, Schenectady, N. Y.*

GENERAL ELECTRIC

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ing and burned in the channels between the joists. Rising heat opened sprinklers under the roof above, but the fire was out of reach. Sections of the ceiling were removed and six small hose streams used, but flames continued to break out in many places. Ultimately, it was necessary to chop through the roof to put the fire out. In rebuilding the ceiling after the fire, the insulation was packed between the joists to avoid hollow spaces. The paper covering was removed where it would be exposed or in contact with the fixtures. No insulation was placed on top of the fixtures.

In preventing fires in cold cathode applications, the principal objective is careful installation of high voltage wires between transformers and tubes. In one case where this was done improperly, roof leakage wet the wiring, arcing followed and the plant burned. Preferred practice is to mount the transformers on the fixture, with all high-voltage wiring inside. Where this cannot be done, it is desirable to place transformers as close to fixtures as possible; reduce the length of high-voltage wiring to a minimum; limit potential on the high side to 15 kv; keep the transformers accessible; use wires of adequate capacity and insulation; and use approved conduit types.

Install 25 Ground Plates to Cathodically Protect Cable

L. F. GREVE
Corrosion Engineer
Commonwealth Edison Co.
Chicago, Ill.

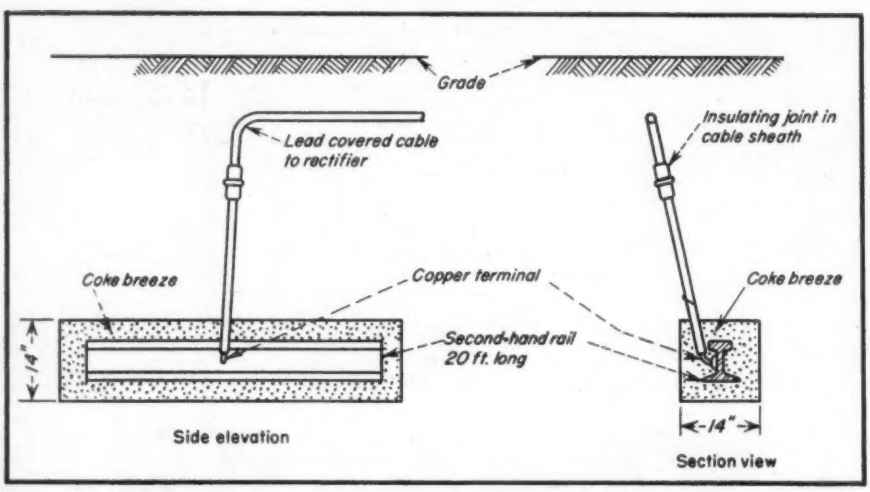
CATHODIC PROTECTION was applied recently to cable sheaths in two locations by installing 25 ground plates at intervals along the cable runs and connecting them to an outside source of d-c potential in such a way as to cause the flow of current from the ground plates to the cable sheaths.

The ground plates consisted of 20-ft steel rails spaced about 100 ft apart and not closer than 10 ft to any one of the cable runs. These ground plates were buried from five to ten feet below the surface and were each imbedded in one-half ton of finely pulverized coke. The latter retards the rate of deterioration of the ground plates resulting from the current flow and also tends to reduce the contact resistance.

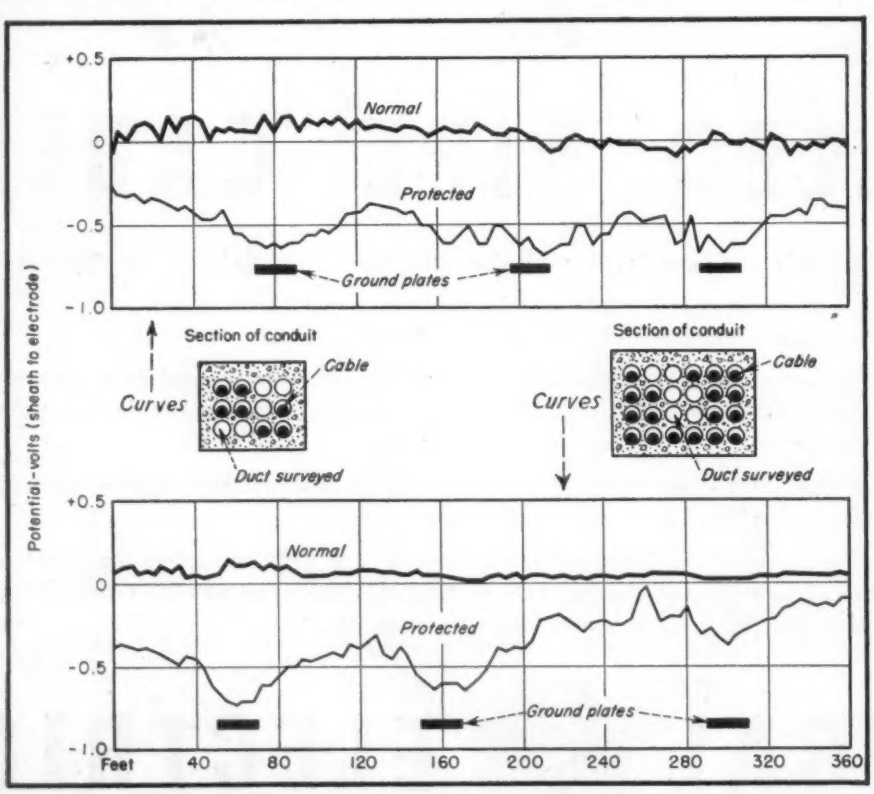
A copper oxide rectifier was used to supply the d-c potential of from one to six volts in steps of one-tenth of a volt. Previous tests had indicated that to maintain the cable sheaths negative to earth in the conduits, a flow of 50 amp from the ground plates would be required. This averages 2 amp per plate.

The voltage of the cable sheaths with respect to the earth along two of the conduit runs before and after cathodic protection was applied is shown in the accompanying graphs. Each graph also shows the relative position of the ground plates with respect to the conduit runs.

This technique of protection was decided upon after two cables failed due to corrosion. The conduit at one location consisted of two duct banks



APPROXIMATELY ½-ton coke breeze is packed around 20-ft rail. A pressed copper terminal is brazed to the rail and a lead covered cable is run to the rectifier



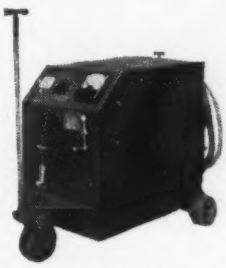
SHEATH POTENTIALS before and after rails were installed along two cable runs.

High-voltage test sets

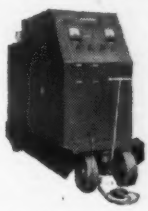
...THE WAY YOU WANT THEM

Portable?

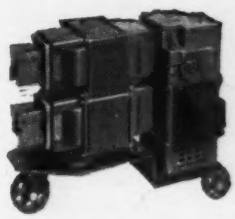
These are popular units!



HIGH POTENTIAL. To 150,000 volts in stepless increments. Operates from 230 v.



HIGH CAPACITY. 300 kva, 30,000/60,000 volts is a widely used set.



HIGH CURRENT. A typical rating is 4000 amperes, a-c. Operates from 115/230 v.

Stationary?

These are suitable for larger installations!

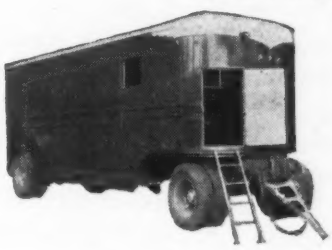
POWER SOURCE. A complete 20-kv, 2-kva tester, for general-purpose testing. Also available in other ratings.

GLOVE-TESTING CABINET. Used with power source, for simultaneous testing of six rubber gloves at 20 kv.

HIGH POTENTIAL. Rated 350,000 volts, 1000 kva, this unit can be cascaded for even higher voltages.

Mobile?

Put a combination on wheels!



Almost any combination of equipments — for substation-to-customer testing, cable testing, high-frequency testing — can be mounted in this 8-wheel trailer — to make a complete, mobile testing set tailored to your needs.

3 BOOKS TO HELP YOU SELECT WHAT YOU NEED

These three 24-page bulletins will be invaluable to you in your work. Write for the ones you need — GEA-4477 on portable a-c sets, GEA-4559 on stationary a-c sets, or GEA-4595 on d-c sets. And for ANY special testing problem, tell us what you require. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

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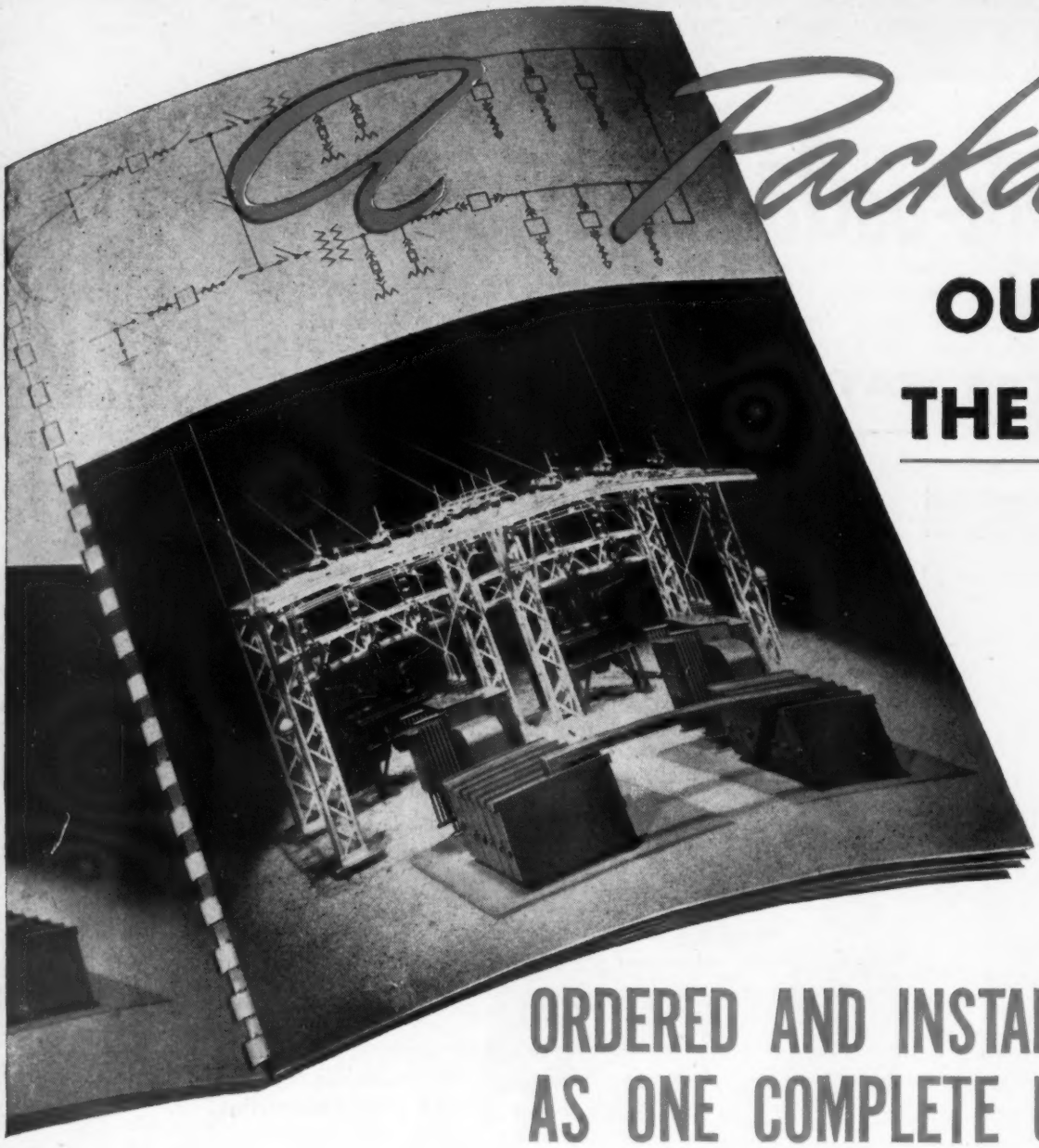


A Package OUT OF THE BOOK

ORDERED AND INSTALLED AS ONE COMPLETE UNIT

Only one order and one set of specifications were needed fo
the equipment of the above substation. Transformers, switchgear, s
work, lightning arresters, disconnects—everything but the conduit, f
dations and enclosing fence—was ordered and installed as a

SAVED TIME—CUT COSTS

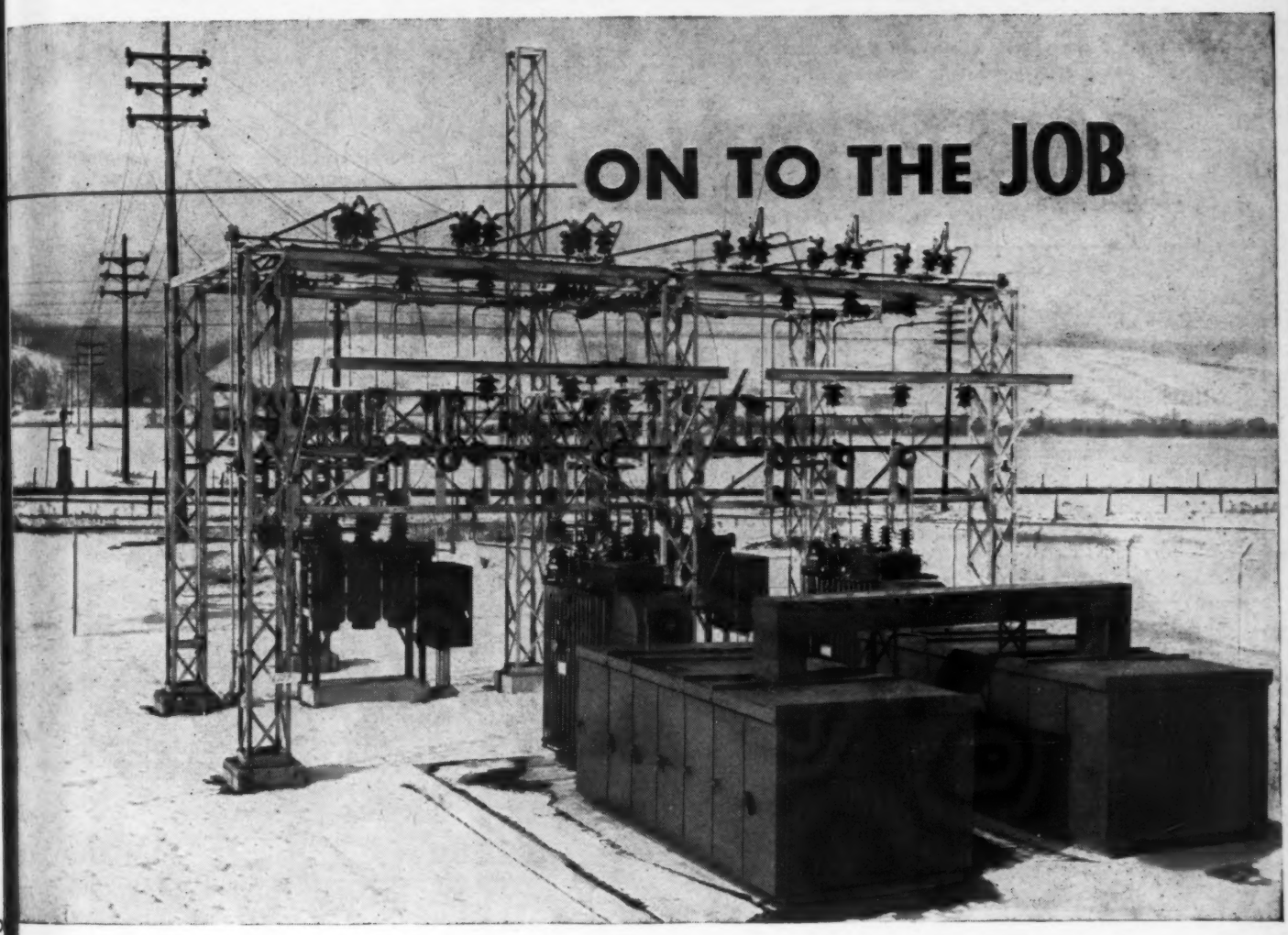
This eliminated months of costly "piecemeal" planning—mad
possible to place the order without delay. It made installation q
and easy too—the package substation was shipped in fac
assembled sections as large as shipping facilities permitted.

More and more utilities are finding it easy, economical and hi
practical to select—from the hundreds of standard designs—a
plete package substation matched to each specific job. They fi
frees system engineers of much detail work on components, lets t
concentrate more profitably on over-all system operations.

A 'PROVED' PRACTICAL APPROACH

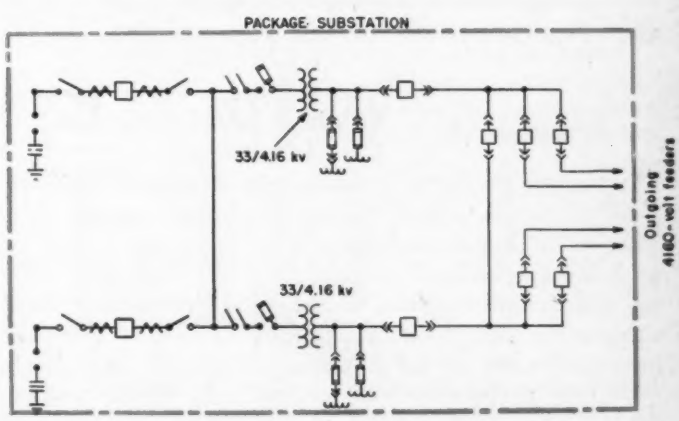
Two years ago G.E. introduced the "Package Substation" as one of the solutions to the difficult economic and manpower problems facing the electric utility industry. The unusual acceptance of the idea is indicated by the fact that over 500 of these complete package substations have been purchased by electric utilities since publication of our package substation bulletin (GEA-4500) two years ago.

Substation . . .



SAVE TIME AND MONEY WITH THE *UNIT APPROACH*
—GET THE COMPLETE SUBSTATION AS A *UNIT.*

Thirty of the basic package substation arrangements are shown in GEA-4500 (left, above). Use it to investigate the *unit approach* to your next substation application. We think you'll be pleasantly surprised. Your G-E sales representative will gladly provide a copy and help you all he can. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*



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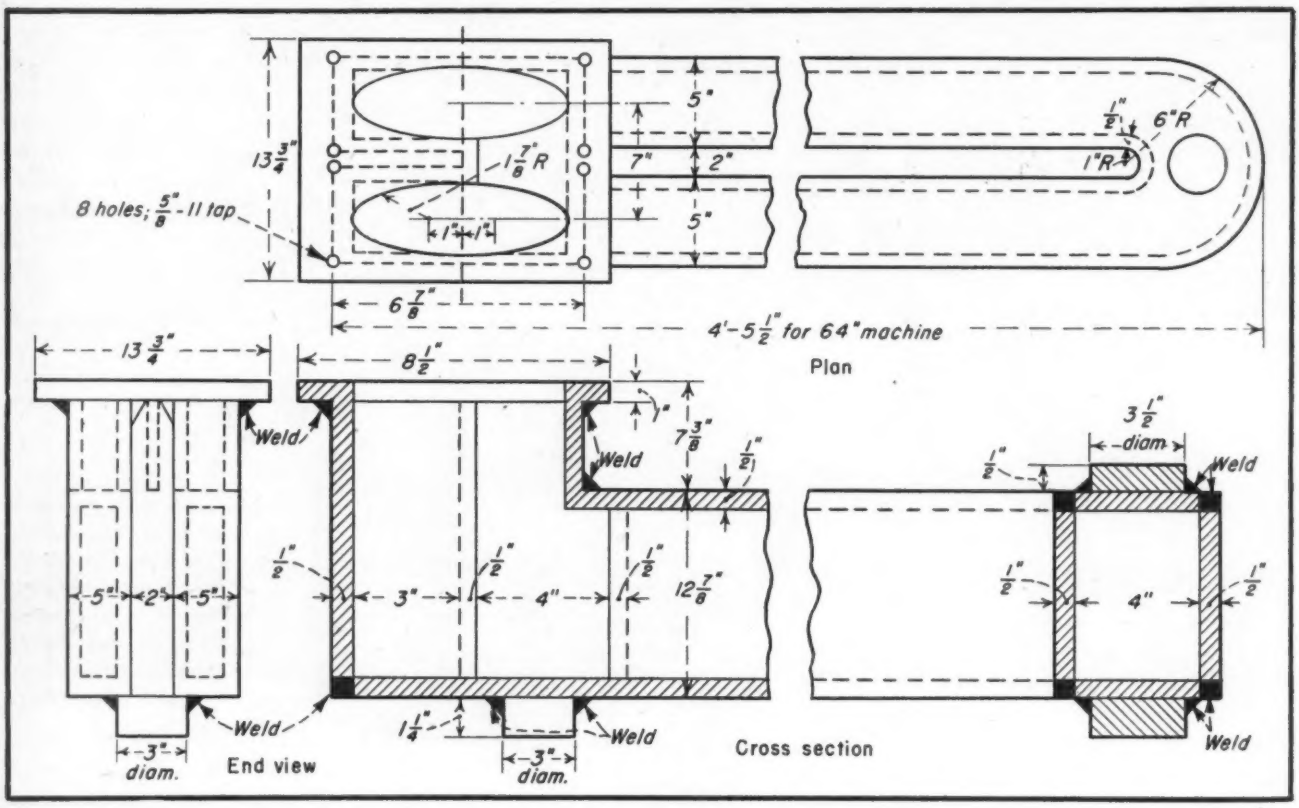
and at the other location one bank which contained a total of 45 cables. The routine sheath voltage readings in the manholes indicated electrolysis conditions were satisfactory and chemical analysis of the water from one of the ducts showed this was not particularly corrosive to lead. One of the cables which had been in service for about 7 years was removed, examined and showed severe corrosion.

Duct surveys indicated a portion of the cable sheaths in the conduits were as much as 0.2 v positive to earth. Four excavations were made and the conduits were found to be in a sandy muck soil. However, a cinder fill extended from ground level down to, and in some places, below the tops of the conduits. Voltage readings in the excavations showed the sheath of the cable to average about 0.5 volt negative to the cinders and to be slightly positive to the sandy muck soil. This difference in potential between the two materials adjacent to the conduits had established a serious corrosive condition. Five additional cables later removed were also found to be severely corroded.

Test excavations were made at other locations on the property and the duct surveys were made in order to determine the extent of the corrosive area. It was found that 18 conduit runs containing about 250 cables were involved and in some cases for a distance of over 1,200 ft. As a result, it was decided that the most feasible method of eliminating the corrosive conditions would be to apply cathodic protection.



ARC WELD DESIGN immersion heating unit fabricated of high alloy low carbon steel throughout

Arc Weld Design Used For Heating Element

PROLONGED LIFE and economy are obtained by designing heating elements of high alloy and low carbon steel, and arc welding* with high tensile strength electrodes. The heating elements are used in a hot dip process for tin plate and are fired by gas.

Highest temperature obtained in the heating element is 1000F, then it is dropped to 650F and maintained constant at 600F in molten tin metal. Steel construction stands more expansion and contraction than the cast iron elements which cracked.

Arc weld design element is illustrated and the costs follow. Material used was 660 lb of $\frac{1}{2}$-in. high alloy low carbon steel plates, cost $24.42; 25 lb of $\frac{3}{16}$-in. HTS welding rod, cost $4.75; total for material $29.17. Labor for machinist drilling and tapping 8 holes, 1.5 hr, cost $2.25; for blacksmith bending two radius plates, 2 hr, cost $2.80; for welder layout and assembly, 6 hr, cost $9; for welding, 14 hr, cost $21; total for labor $35.05.

Total cost for an arc weld design element is $64.22, for a cast iron element is $179.64; saving for each element is $115.42.

Based on a replacement of 24 elements for one year, the total saving is $4,311.36 minus $1,541.28 or $2,770.08, and approximate saving is 64.3% per year.

With 15 tin pots operated 5 days per week for a year, 24 cast iron elements were used having an average life of 5 months each. Time lost due to changing of cast iron elements was 48 hr for the year.

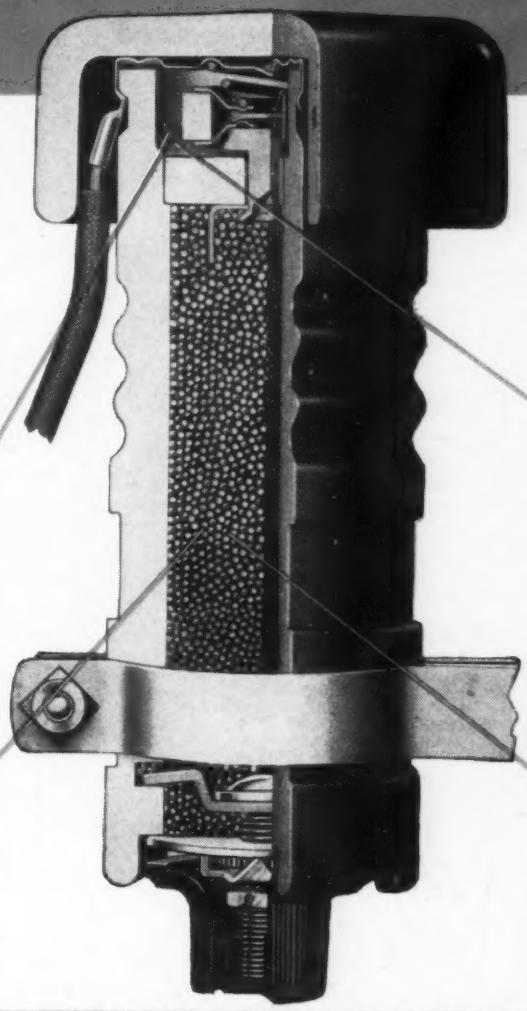
---

* Data adapted from a study submitted to the James F. Lincoln Arc Welding Foundation by Leo Kula, Inland Steel Co, East Chicago, Ind.

Get that extra protection

SPECIFY G-E PELLET ARRESTERS

The Quality-Standard of the Industry for more than 25 years



For extra protection for your Distribution Transformers

Low initial sparkover voltage to start discharge. The impulse sparkover voltage of a 3-kv pellet arrester, for example, is *less than one third* of the AIEE impulse test level, and *even well below the crest value of the 60-cycle one-minute standard test* of 2400-volt transformers.

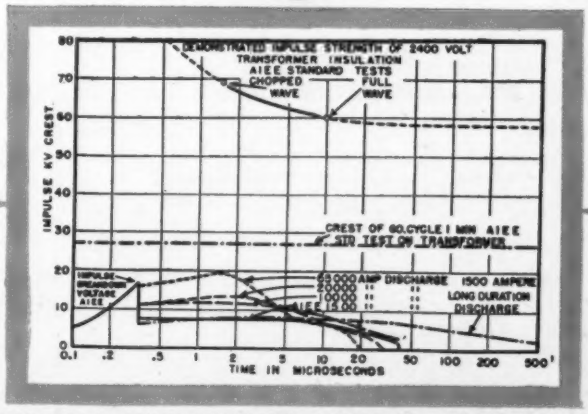
Exceptionally low IR drop during discharge. The efficiency of the G-E pellet type valve-element is tops — it provides valve action and holds lightning voltage stresses to exclusively low levels—while protecting against low, medium, or high lightning currents.

For extra protection for the Arrester itself

Dry Nitrogen is sealed into the gap chamber of all G-E pellet arresters — an *exclusive G-E feature*. This dry, inert gas prevents formation of ozones or oxides — keeps the gap electrodes bright as new during years of service operation.

Pellets, themselves, are of dioxide of lead — *a distinctive valve material whose characteristics are unaffected by moisture*. Therefore, the pellet valve-element is self-protecting against service moisture, condensation or humidity — another reason for pellet arrester reliability.

Extra overall protection. This curve was made from actual volt-time and ampere-time cathode-ray oscillograms of a 3-kv G-E pellet arrester. Even at 65,000 amperes discharge current, the maximum voltage stress on the transformer is *but a fraction of* the impulse test level of modern 2400-volt transformers and assures a *wide margin of protection to even very old transformers.*


DEMONSTRATED IMPULSE STRENGTH OF 2400 VOLT TRANSFORMER INSULATION
AIEE STANDARD TESTS
CHOPPED WAVE
FULL WAVE
CREST OF 60-CYCLE 1 MIN AIEE STD TEST ON TRANSFORMER
IMPULSE BREAKDOWN VOLTAGE AIEE
65,000 AMP DISCHARGE 1500 AMPERE
20000 " " "
10000 " " "
AIEE 15.00 " " "
LONG DURATION DISCHARGE
IMPULSE KV CREST
TIME IN MICROSECONDS

The G-E pellet arrester *will handle severe lightning stroke discharge currents*—all ratings will readily withstand the AIEE and NEMA standard 65,000-ampere test. And — typical cathode-ray oscillograms obtained on G-E pellet arresters of various ratings, after 6 to 19 years of service where subject to frequent and severe discharges, prove that *pellet arresters retain unexcelled protective characteristics.*

APPARATUS DEPT., GENERAL ELECTRIC COMPANY, SCHENECTADY 5, N. Y.

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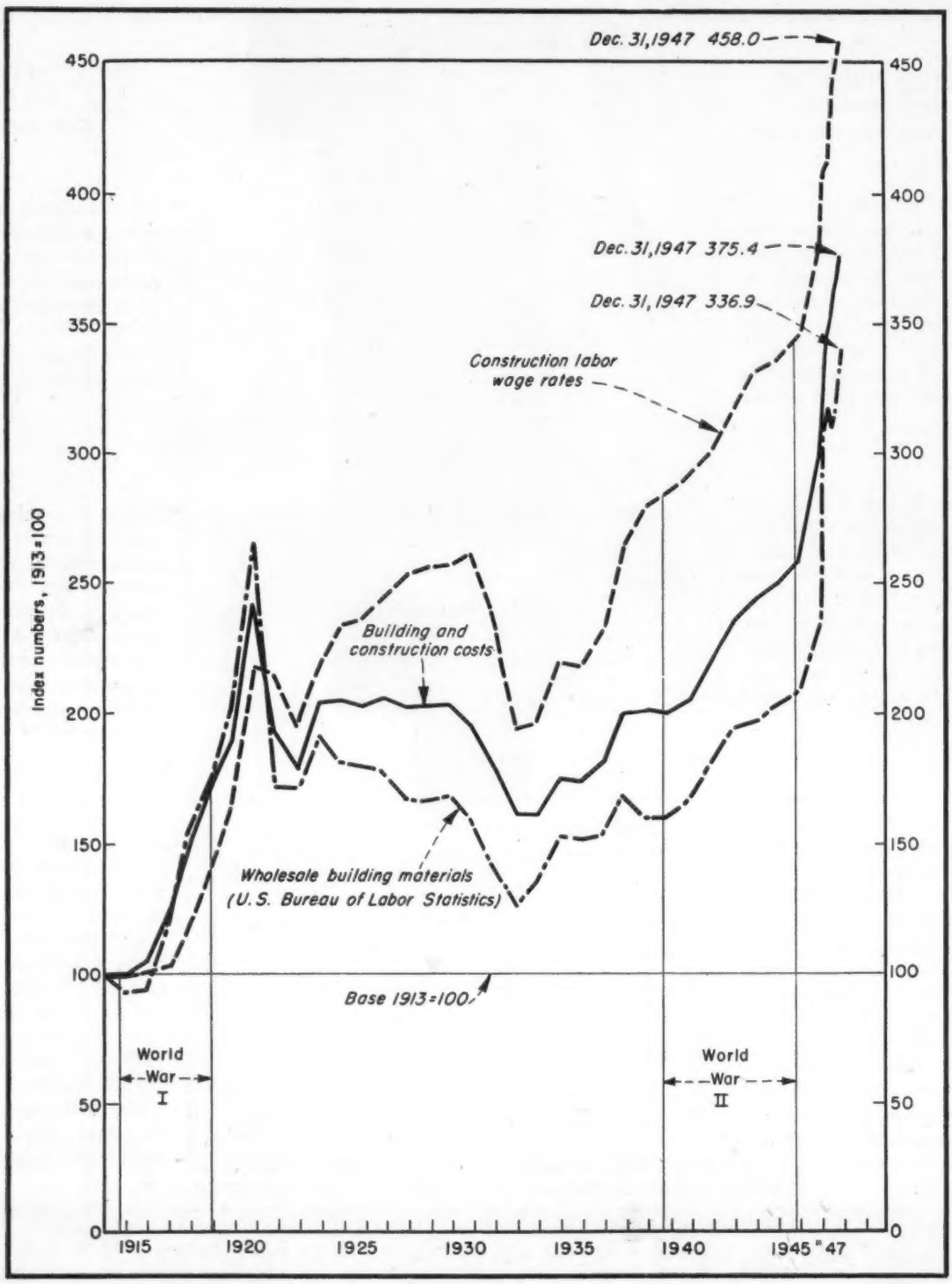
Cost Trends for Steam Electric Stations

Graph provides indexes for construction costs, wages and building material, based on construction cost trends 1913-1947

From "The Upward Trend of Construction Costs" by F. C. Gardner
Vice President, Ebasco Services Incorporated, New York



REVERE detects *VIBRATION* at a distance

DO you know that vibration can be present in the tubes of a condenser, though not perceptible in the shell? Putting the palm of your hand on a condenser is not a good test for destructive vibration. The best test is one carried out in the Revere Research Laboratory in Rome, N. Y., which makes a microscopic examination of the metal as a part of its work in determining causes of tube failure. If vibration contributed to short life, this examination will show it. Vibration accelerates corrosion in several ways. The alternating stresses in time produce cracks across the grain of the metal, weakening it and giving corrosive fluids more points to attack. Vibration also breaks or disrupts or disturbs the thin film on the surface of the metal that protects it and helps reduce the rate of corrosive attack. Of course vibration is but one of a number of factors influencing the service life of condenser tubes, and so when tube life is questioned we always suggest that samples from failed tubes be sent to us. We may be able to help you, as we have others, with suggestions that should materially extend the period between re-tubings.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, New York

Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; New Bedford, Mass.; Rome, N. Y.—Sales Offices in Principal Cities, Distributors Everywhere

Cost of Conductor Losses Quickly Analyzed from Graphs—II*

MERLE H. ATCHESON
Assistant Electrical Engineer
Sierra Pacific Power Company
Reno, Nevada

TO TRANSFER the family of curves from an ampere base to a kva base, such as shown in accompanying chart (Fig. 2), we need only to establish one point on the new chart for any one of the established conductor sizes. By maintaining the annual cost index lines in the same location and overlaying the one new point on its proper conductor size, the entire chart can be traced from the original. (Use identically ruled transparent graph paper). This simple transfer technique is also effective for change of loss cost rates or change of voltage.

Change of circuit voltage will shift the curves to right or left in direct ratio to the voltage change. Change of basic cost of losses per kw at peak will shift the curves right or left inversely as the square root of the price change ratio.

After several family curve groups have been retraced for various voltages and for annual costs representing anticipated load factors, the preliminary selection of conductor sizes is much simplified. Starting with the expected annual peak, follow the peak kva line up to its intersection with the economic peak line at which point the nearest conductor size is chosen.

Traditional methods may be employed for distributed loads. If stepped down conductor sizes will be allowable along the circuit length various sections can be separately analyzed. If it is desired to use a fixed conductor size for the full length of a circuit with distributed load, the entire load may be lumped at 1/3 circuit length for losses, but investment charges must be applied to the entire circuit length. A new economical load line may then be shown on the charts for this condition.

Although a single basic chart can be made and multipliers developed for various conditions, it will be found relatively simple to repeat the chart for change of conditions and thus have available direct reading graphs from which to make preliminary or even final conductor selection. The dollar value of increasing conductor sizes or raising circuit voltages may be analyzed with less computation. Load increases may be projected into the future and the corresponding loss costs quickly tabulated.

Of course voltage regulation must be given proper consideration, but on many short line jobs it will be found more economical to select wire sizes on a cost-of-losses base than on voltage drop.

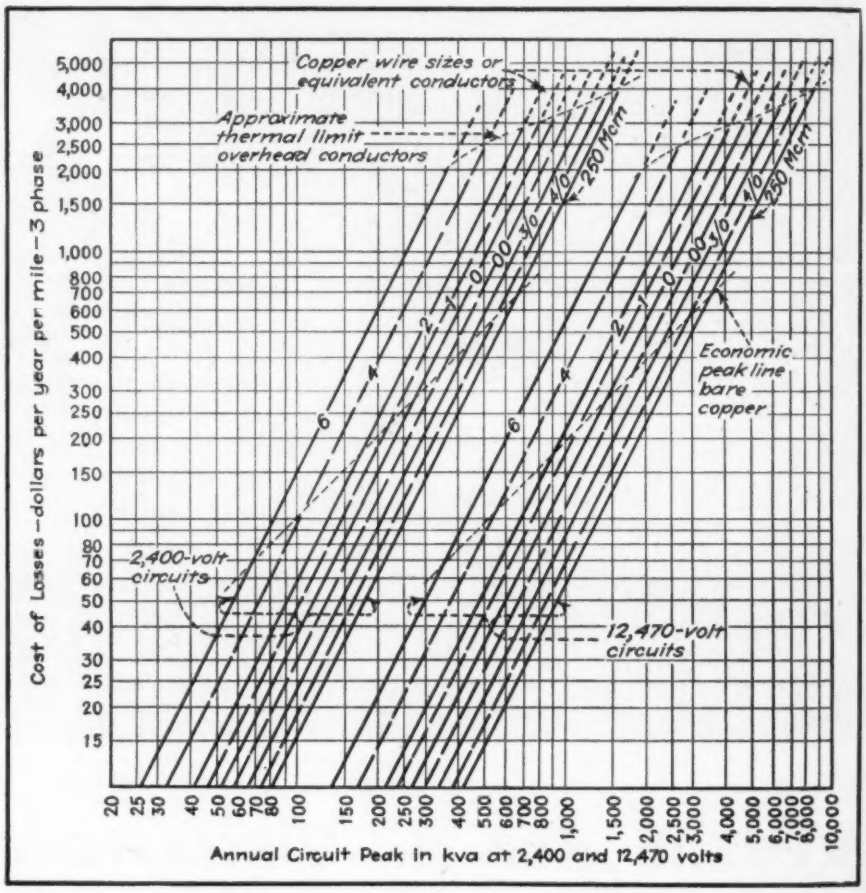
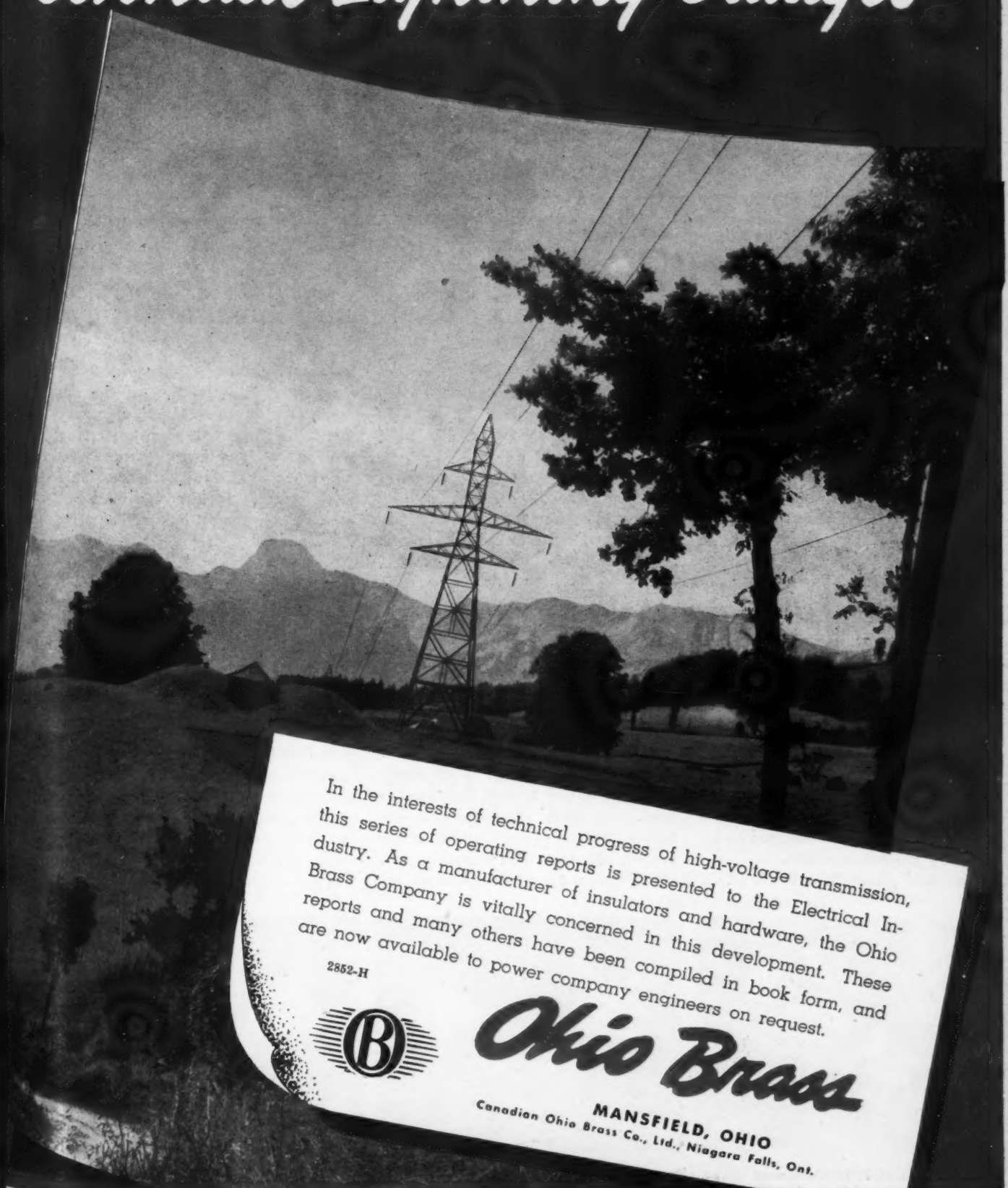

Copper wire sizes or equivalent conductors
Approximate thermal limit overhead conductors
Economic peak line bare copper
2,400-volt circuits
12,470-volt circuits
Cost of Losses—dollars per year per mile—3 phase
Annual Circuit Peak in kva at 2,400 and 12,470 volts

FIG 2—COST OF LOSSES per mile of 3-phase line; conditions (a) for high load factor circuits and (b) at $36 per year per kw loss at time of annual circuit peak load

* Concludes serial which began in ELECTRICAL WORLD, August 28, 1948, page 98

Transmission across Annual Lightning Outages



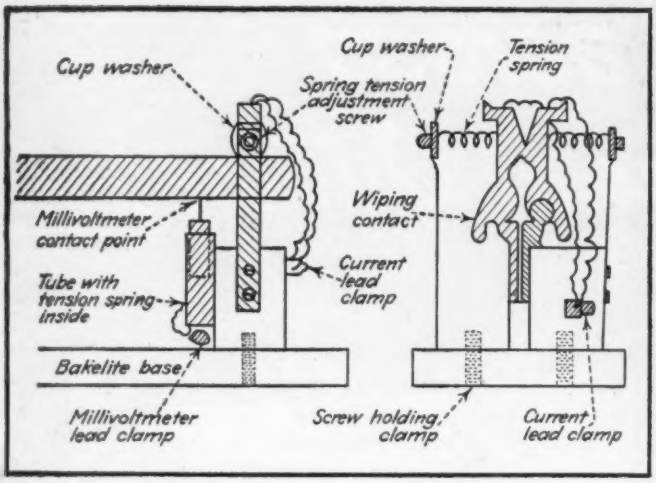
In the interests of technical progress of high-voltage transmission, this series of operating reports is presented to the Electrical Industry. As a manufacturer of insulators and hardware, the Ohio Brass Company is vitally concerned in this development. These reports and many others have been compiled in book form, and are now available to power company engineers on request.

2852-H

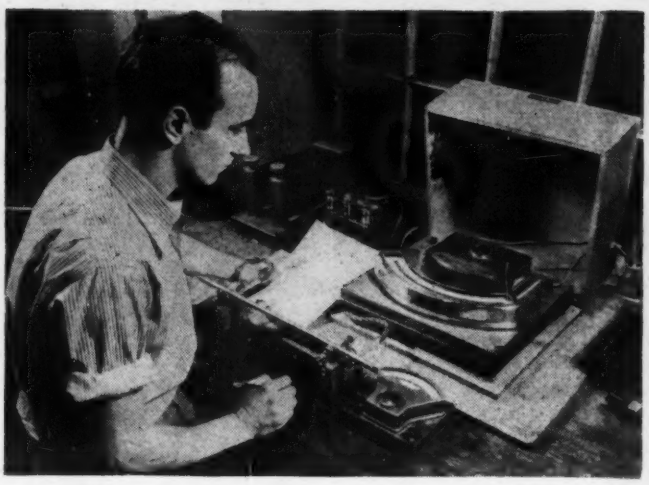
Ohio Brass

MANSFIELD, OHIO

Canadian Ohio Brass Co., Ltd., Niagara Falls, Ont.



DEVICE DETAILS. Screw holding clamp can be adjusted so that 6, 8 and 10 in. can be obtained between meter contact points



CLAMPING DEVICE holds and at same time measures resistance of damper rod, shown in front of operator

Device Simplifies Damper Rod Resistance Measurement

A DEVICE that facilitates obtaining resistance measurements of damper rods has been developed by technicians in the Allis-Chalmers calibrating laboratory. Details are shown.

In use, the rod for damper windings and squirrel cage rotors is merely slipped between a pair of spring contact clamps; at the same time millivoltmeter leads, in the form of two sharp points preset to the proper distance, contact the rod, giving a fast accurate reading. In addition, the quick operation of the new test set-up eliminates inaccuracies in readings previously encountered by heating. Present arrangement accommodates rods up to $\frac{3}{4}$-in. diameter.

Formerly, they were tested by measuring and marking off the desired distance on each rod, clamping the rod with thumb screws, starting the current, and applying millivoltmeter leads at the markings. This job previously required two men but is now performed in a single step by one man.

Scaled Globe Measures Bulb Light Distribution

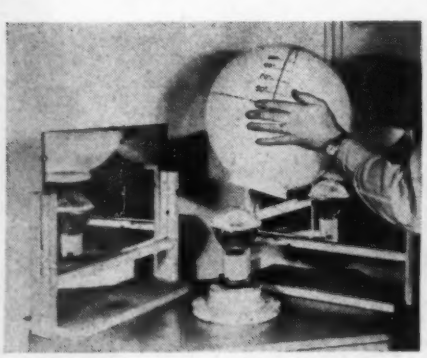
WITH THE AID of a globe having graduations, the light distribution of lens-type bulbs can be appraised quickly. The device is a development of Sylvania Electric Products Inc, Salem, Mass. Primary value of the globe is with those reflector-type lamps whose light distribution pattern is too wide to be measured on an ordinary projection screen.

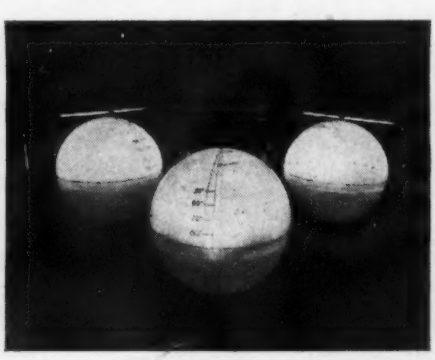
The opal glass globe is 16 in. in diameter, has an opening $5\frac{1}{4}$ in. in diameter so that it can be placed over the bulb such as the street lamp shown in the illustration.

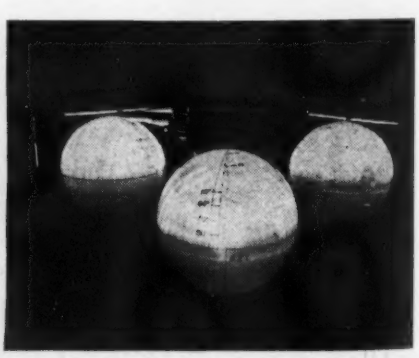
Filament placement in any reflector lamp is very critical, particularly when a prismatic type of glass bowl is used. Any bulb which through improper location of the filament or improper alignment of the basing, and which does not meet the specifications for beam pattern, can be detected easily and quickly by means of this test.

In the test illustrated, a streetlight was used which employes prisms to direct light up and down the street.

The lamp under test (right illustration) was found to give off a streaky pattern of light despite the fact that the principal beam was at an angle of about 72 deg. If that lamp was put into use, the same lines on the

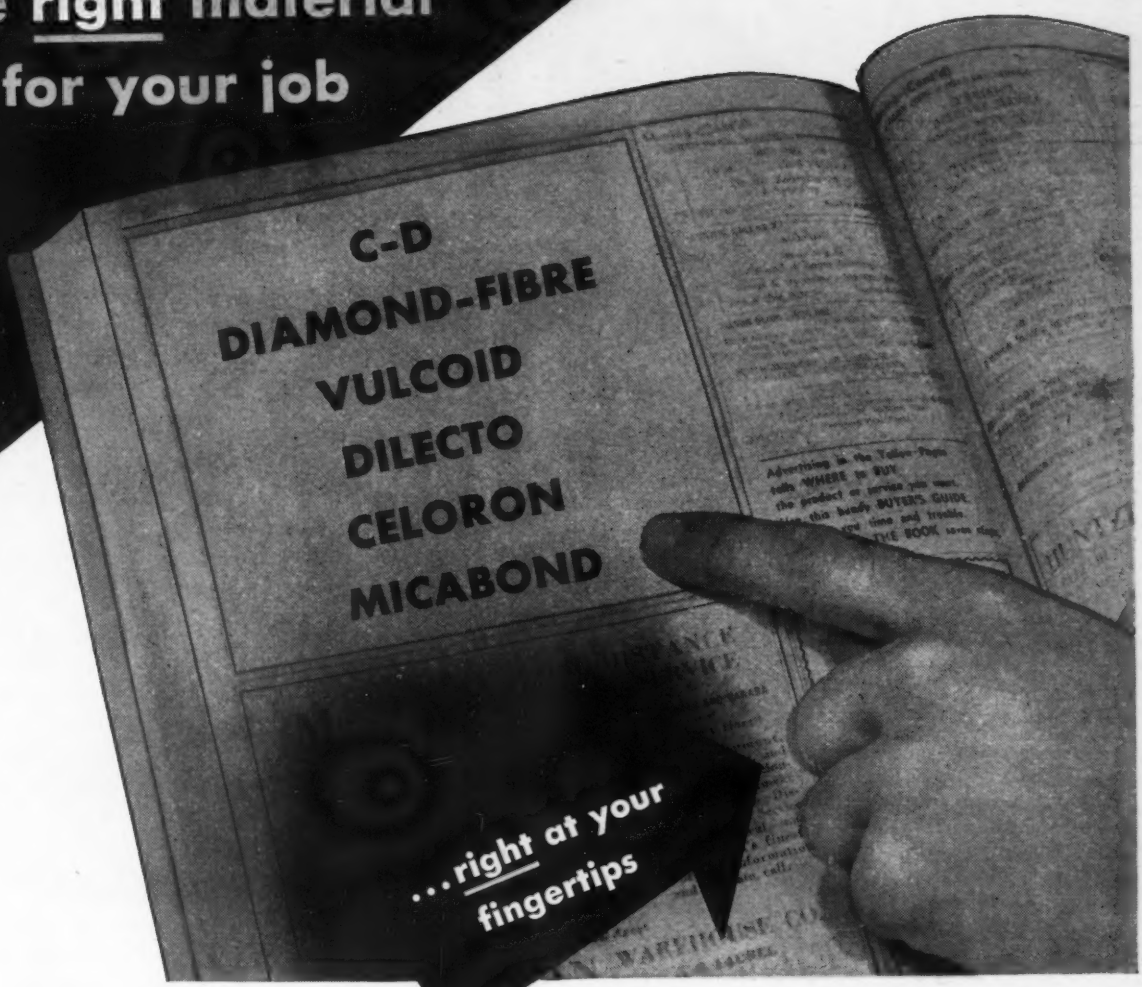






LIGHT DISTRIBUTION is measured by opal glass globe set on standard holding reflector-type bulb. Two mirrors are placed at angles to rear of lamp so that complete distribution pattern can be observed. Smooth beam pattern shown in center illustration, streaky pattern at right

the right material for your job



If you want to get the electrical insulating material best suited to improve product performance, here's an engineering service worth investigating. Experienced Continental-Diamond engineers will welcome the opportunity of working with you from the start of a job to its completion. Backing them up is a *complete* line of insulating plastics with unusual combinations of electrical, chemical and mechanical properties. There's *Diamond Fibre* for toughness, wear resistance, and light weight, *Vulcoid* for superb arc resistance, toughness, good dielectric strength and fair moisture stability, *Dilecto* for structural strength and dimensional stability. All in all, there are five different C-D Plastics subdivided into grades to fit your specific application.

Take advantage of this complete plastics service designed to help you improve product performance, lower unit costs. For personal engineering help or prompt delivery of insulating plastics, call your nearest C-D office today.

C-D HIGH-STRENGTH PLASTICS

Diamond Fibre—Vulcanized Fibre
Vulcoid—Resin Impregnated Fibre
Dilecto—Laminated Thermosetting Plastic
Celoron—Molded High-Strength Plastic
Micabond—Bonded Mica Splittings

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Continental-Diamond FIBRE COMPANY

Established 1895 . . Manufacturers of Laminated Plastics since 1911 — NEWARK 15 DELAWARE

globe would appear as streaks on the pavement.

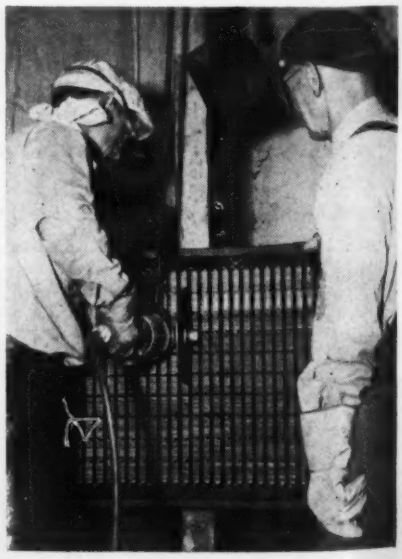
In the final step of the test (center illustration) a lamp was used in which the streakiness was eliminated by use of greater diffusion. The design provided the desired smooth beam pattern, with the maximum amount of light at 72 deg. For the specific case an angle of 72 deg. was used as the most suitable angle for street lighting purposes to avoid glare yet provide adequate distribution of light on the street.

By marking the tolerance limits of the principal beams of light on the sphere, the globe can be used for quality inspection on production lines.

Grinder Speeds Slot Finishing

CARBORUNDUM DISCS driven by a portable angle electric surfacer, as shown, proved solution to the problem of finishing slots in an emergency repair job made by the Washington Water Power Co, Spokane, Wash. New laminations were required for a 3,000-kw unit at its Nine Mile hydro plant damaged by lightning. Core laminations removed from an abandoned transformer were used. With locally made dies the laminations were cut to size in one operation. The slots were then stamped one at a time using a die and jig.

Instead of draw filing slots in the stacked core in the customary man-



LABOR COST REDUCED 75% by using portable grinding tool for finishing slots in generator laminations on emergency repair job. Note counterweight

So you did break your neck to get genuine Crosby Clips!

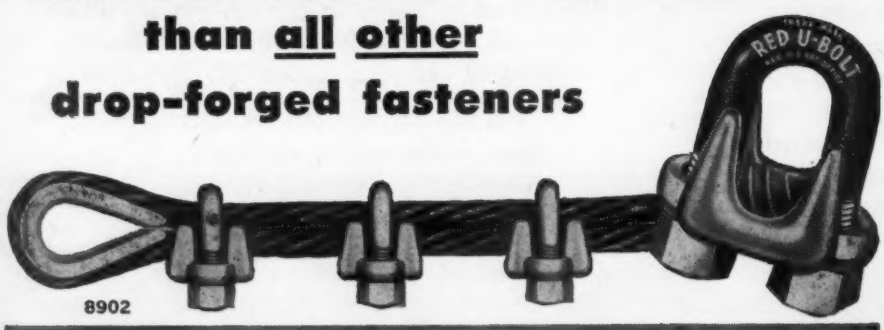
Why stick your neck out, in buying wire rope fasteners? The difference in cost between genuine CROSBY CLIPS and the cheapest fasteners you can buy is certainly not much of an item. CROSBY CLIPS are *drop-forged*—not cast. Channel grooved base, high side wings, chamfered bolt ends, are priceless features of quality. Sold by distributors everywhere, in sizes from ⅛" to 3".

Made only by AMERICAN HOIST & Derrick Co., St. Paul 1, Minnesota.

Industry uses more

CROSBY CLIPS

than all other drop-forged fasteners



For Armored Construction . . . specify AMERICAN BLOCKS AND SHEAVES

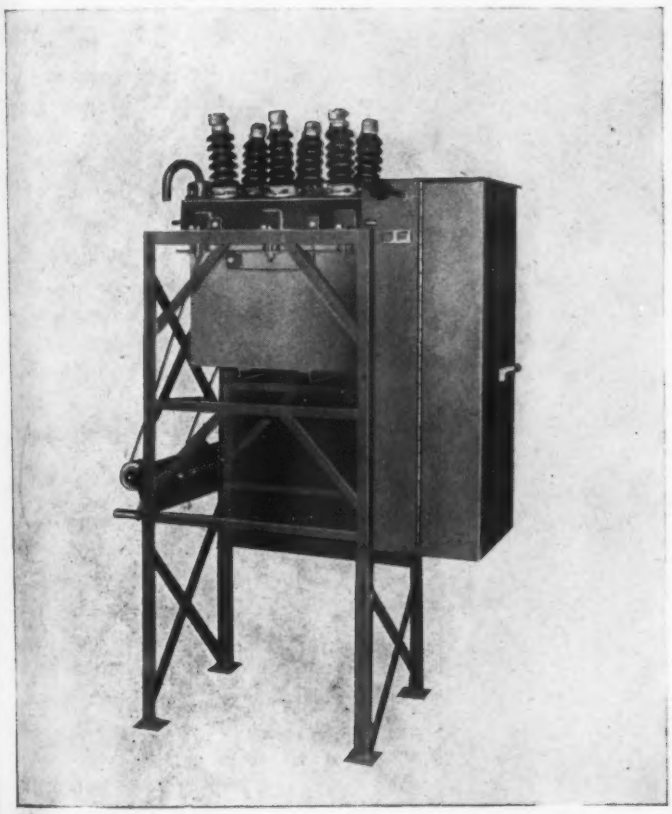
● A complete line of wire rope blocks—all types, all sizes, in capacities from 1½ to 250 tons. Thick steel side plates, heavy pins and axles. Ask for American equipment when ordering.

ONE MAN LIFTS 10,000 LBS. WITH THE AMERICAN HANDIWINCH

● Gives one man the power of a crew. Weighs only 95 lbs. Handles lifting, loading and pulling jobs up to 5 tons. All steel construction. Ask your distributor.

Engineers . . . KNOW WHAT THEY WANT

Utilities and Industrials enthusiastically accept Roller-Smith Outdoor Exotherm Breakers for the high standards of engineering craftsmanship and materials incorporated in all Roller-Smith circuit breakers.



ROLLER-SMITH OUTDOOR OIL CIRCUIT BREAKER

Outdoor Oil Circuit Breakers are available in the following classes: 50-OC-1: 600 amperes, 7500 volts, 50,000 KVA I.C.; 50-OC-11: 600 amperes, 15,000 volts, 50,000 KVA I.C. and 100-OC-11: 600 amperes, 15,000 volts, 100,000 KVA I.C. manually operated, d.c. solenoid operated or a.c. rectified solenoid operated.

CHECK THESE OUTSTANDING FEATURES

- *Exotherm Arc Extinction*—Short interrupting time—less contact burning—less oil sludging.
- *Arcing Contacts*—Heat resisting "ELKONITE" arcing surfaces.
- *Shock Absorbers* — Sturdy construction — dissipates energy of opening stroke.
- *Terminal Connectors* — Convenient, reliable, bolted type.
- *Current Transformers*—Bushing type—low excitation current.
- *Porcelain Bushings*—Wet process type.
- *Operating Mechanism* — Rugged construction — trip free at any moment of closing stroke.
- *Position Indicator*—Mechanical, visible indicator.
- *Oil Separator*—Centrifical type; removes oil from exhaust gases.
- *Breaker Frame and Tank*—Continuous seam welded —weather proof—oil tight.
- *Mounting Frame*—Rigid electrically welded construction.
- *Tank Lifter*—Portable, windlass type.

More than 40 years of research and experience is your assurance of reliable performance.

SEE US AT THE IRON & STEEL SHOW, CLEVELAND, OHIO, SEPT. 28TH THRU OCT. 1ST

ROLLER SMITH

Sales Representatives in all Principal Cities

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BETHLEHEM PENNSYLVANIA

ELECTRICAL INDICATING INSTRUMENTS • AIRCRAFT INSTRUMENTS • SWITCHGEAR
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In the field of electronics and the electrical goods industry, MOSINEE stands for paper-base processing materials with scientifically controlled chemical and physical properties, high quality standards and dependable uniformity... with good dielectric strength, high tensile or tear strength; proper softness or stiffness; creped with controlled stretch or flexibility; specified pH for maximum-minimum acidity or alkalinity; accurate caliper, density, liquid repellency or absorbency . . . or other technical characteristics vital to your quality standards and production requirements.

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ner the grinding tool mentioned, using a 9 in. by $\frac{1}{8}$ in. carborundum disc, was employed to save time. Guides attached to the tool operated in the previously finished slots to keep the grinding device in alignment and of proper depth. To make it easier for the operator a counterweight on the tool was used as illustrated.

Time Switches Group Tested on Special Panel

C. MORSHER
Meter Department
The Ohio Public Service Co
Elyria, Ohio

GROUP TESTING of time switches for both accuracy of the timing motor and correct operation of trip mechanism and contacts under load, is done at the Elyria Meter Dept of The Ohio Public Service Co, on the special six-position test panel shown. Before this panel was installed, time switches were tested for running accuracy only; contacts and trip mechanisms were checked visually.

Six sockets are set with the sheet aluminum panel. These sockets are mounted in two three-meter indoor-type troughs with removable covers. Electrical supply to the sockets is controlled by a 20-amp breaker-type switch. The supply to 120-v outlets on the panel, series test plug and potential studs is independent of time switch supply and is protected by a 15-amp fuse.

Independent loading of each time switch is accomplished with six 100-watt lamps mounted in porcelain sockets on a sub-panel behind the outer panel. These lamps protrude through the outer panel, however, for heat dissipation. Glare is controlled by shields spring-clipped to each lamp.

The load sides of the time switch

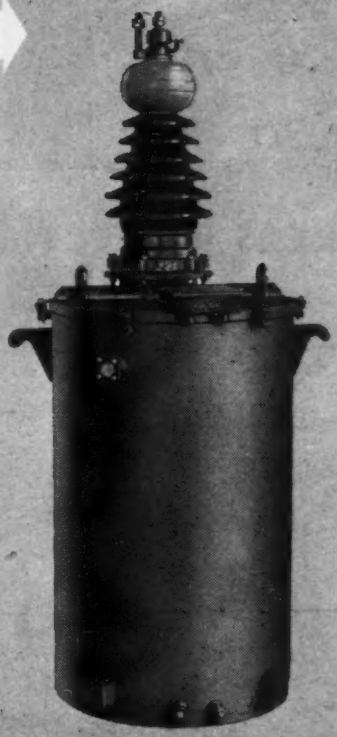
(*Continued on page* 132)

GANG TEST PANEL checks operation of time switches under load. Panel can test six switches in a group

INSTRUMENT TRANSFORMERS

Standard Type PWO
Potential Transformer
34,500 to 120 volts.

Standard Type CWO
Current Transformer
50/5 Amperes for use
on 46,000 Volt Circuit.



RANGE OF STANDARD INSTRUMENT TRANSFORMERS

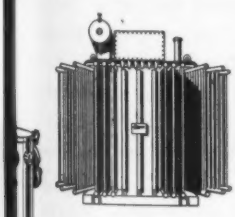
Current and Potential—For service on circuits of voltage ratings through 72,000. Dry types (compound filled) for voltages up to 15,000 on indoor applications, liquid filled outdoor types for voltages through 72,000.

Metering Transformers—Current and potential units combined in one tank for accurate metering of power, single or three phase ratings up to and including 72,000 volts.

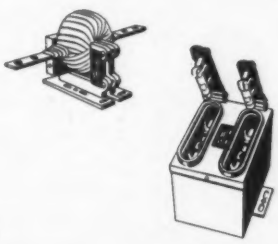
Standard has always been a leader in the field of instrument transformer design and manufacture. The line is complete, including types for control as well as measuring applications.

Specify Standard Instrument Transformers. There are representatives in all principal cities.

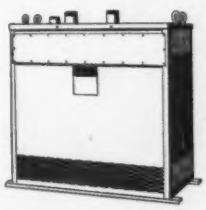
TRANSFORMERS FOR EVERY APPLICATION



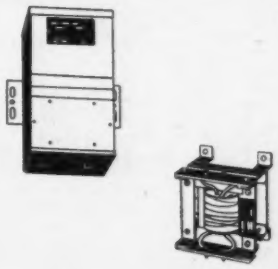
uid filled (sizes up to
00 KVA and 72 KV inc.)



Instrument transformers (for use on circuits up to 72,000 volts, inc.)



Dry type (up to 1000 KVA and max. voltage ratings of 4800)

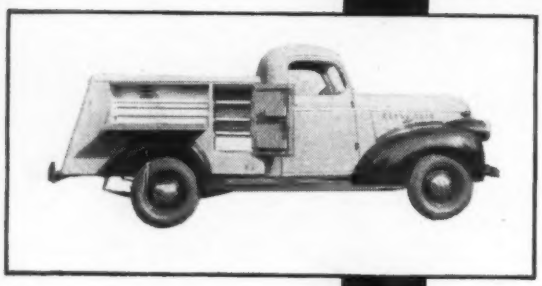


Control transformers (compound filled or open type.)

TRANSFORMER CO. WARREN, OHIO.

Rural · General Purpose Dry Type · Auto Transformers · Street Lighting

It takes DEPENDABLE SERVICE to keep customers . . .



that's why YORK-HOOVER BODIES are re-ordered again and again

Specific purpose design — dependable service — low maintenance service—that's what operators are getting from YORK-HOOVER BODIES. And so the number of York-Hoover repeat customers is constantly growing.

To meet this healthy, steadily growing demand, York-Hoover has increased plant and production facilities so that we hope to say "prompt deliveries" in the not too distant future.

YORK-HOOVER BODY DIVISION CORPORATION

YORK, PENNSYLVANIA

(*Continued from page* 128)

contacts are connected through lamps to a common bus that is connected in series with a set of external studs and the element of a recording ammeter and returned to neutral. Scale of the ammeter is calibrated to indicate full scale when all six loads are on. The pen advances one sixth of the scale with each load applied. Groups of switches are tested over-night and results of tests examined next morning.

Salvaging Used Cable—IV*

W. H. MEADE
Technical Standards and Test Section
Boston Edison Co

WHEN SALVAGING rubber-lead cable the procedure is less involved than with paper-lead cable, but is no less important. Rubber insulation is less susceptible to moisture contamination than paper and oil. This, coupled with the fact that these cables as used at Boston are generally single-conductor and of lower voltage than the paper cables, makes sheath cleaning, inspection and repair uneconomical. However, sheaths are given a cursory inspection on reel or coil. If the sheath is questionable the cable is at once junked. If the sheath is in reasonably good condition, the insulation is given physical inspection and electrical tests. The former determines if the rubber has hardened or has otherwise become objectionable. Electrical tests are made as follows:

On all 5-kv rubber and lead cable a power-factor test is made at about 10 kv. Readings are taken at the start and every 5 min for a 20-min test. If the power-factor increases not over 12% between the initial and final readings and the final reading is not over 10%, the cable is approved for 5-kv service. Cables so approved are given a 25-kv d-c test for 5 min.

The cables are then classified as ozone-resisting or non-ozone-resisting by placing samples in an atmosphere containing 0.01% O_3 for 3 hr. Cables which fail to pass these electrical tests may be derated to 600-v service. On all 600-v cable a simple insulation resistance test is made with a 1-kv insulation tester. Insulation resistances around 400 megohms per 100 ft are considered satisfactory.

* Continuation of a five-part serial which began in EW, July 31, 1948, p 116.

constant fineness of pulverization

3

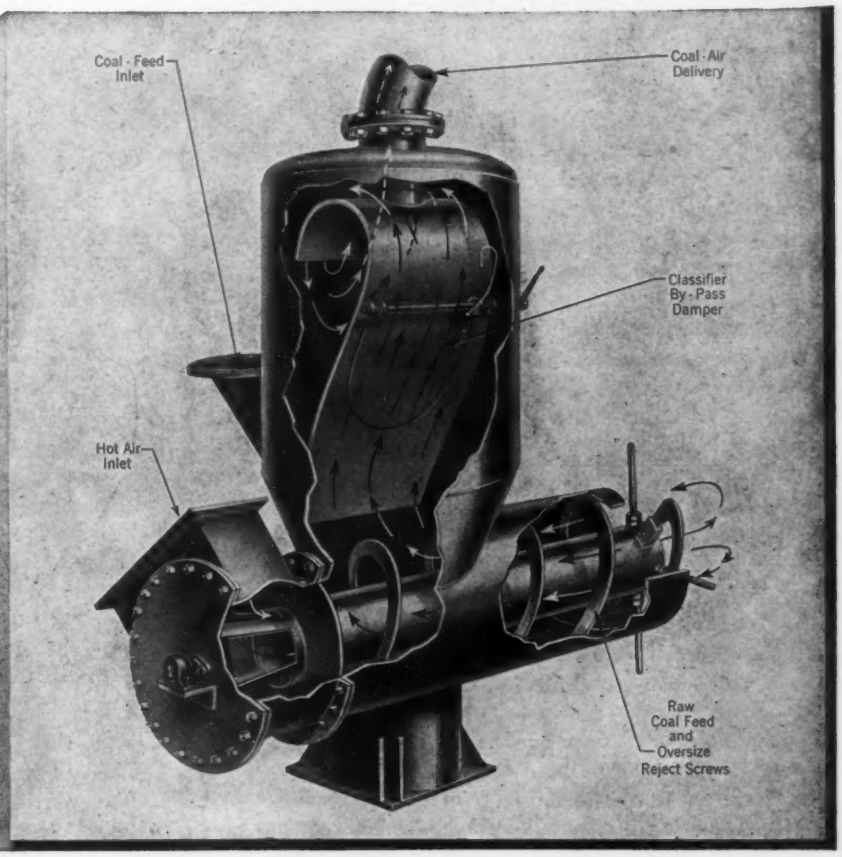
Regardless of its length of service, the FW Ball Mill—with a given coal and under uniform conditions—pulverizes fuel to a constant fineness. As the forged steel balls wear, they are replaced by the addition of small quantities at selected intervals while the mill is in service, thus maintaining the pulverizing medium at peak efficiency. Because of this, the FW Ball Mill has a much higher availability than other mills which must shut down frequently for replacement of worn parts.

Decided advantages of constant fineness of pulverization are:

Uniform Combustion • Reduced Slagging • Higher Sustained Annual Boiler Efficiency—Reduced Carbon Loss.

FOSTER WHEELER CORPORATION • 165 Broadway, New York 6, New York

FOSTER WHEELER



Cutaway view of classifier assembly. Preheated primary air enters the ball mill through a central air tube at each end of the mill. This air picks up its load of pulverized coal in the mill and travels through the annular space around the central air tube. In the classifier the coal-air stream is subjected to a cyclonic action that throws out oversized particles which are returned with the raw coal feed. The coal-air stream, containing only pulverized particles of required fineness, leaves the classifier through the center outlet shown at top.

LOAD BUILDING

What Sells Electric Cooking?

TOM SCULLY
Sales Manager Electric Div,
Griswold Mfg Co, Erie, Pa
and
Chairman, Commercial Cooking Section
National Electrical Manufacturers Assn

A POWER COMPANY's commercial salesman is one man whose mission in life is minding everybody's business and making something of it. It is particularly true when he enters the food service field and turns his attention to commercial electric cooking.

The basic knowledge that a commercial cooking salesman needs is a firm, unassailable conviction that *"If other fuels were free, the restaurant man would be dollars ahead if he cooked electrically!"* Italicize these words—paraphrase them if you will, but print them large and boldly on your salesman's heart. They are the words and the spirit that turn selling into a crusade.

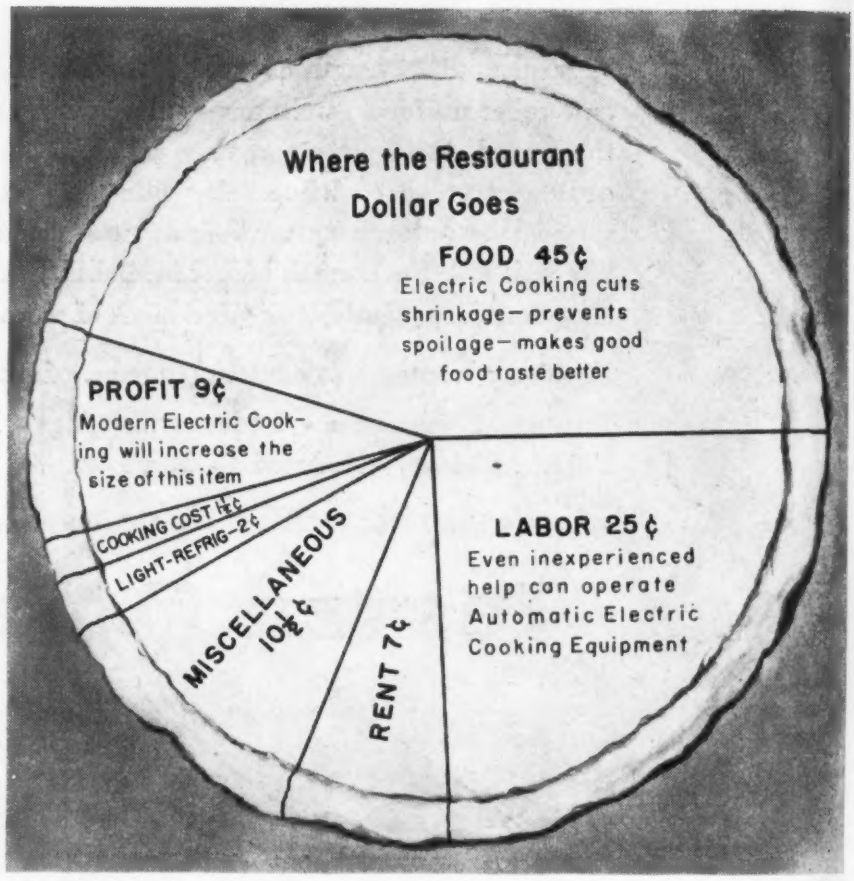
A salesman may have to accept this doctrine on faith when first offered. But experience in the field will bring him to a recognition of its truth. When his customers find new profits in electric cooking they will supply him with facts that will send his enthusiasm soaring up to new heights.

Here are some facts that will enrich the utility salesman's knowledge of restaurant economics. The familiar $1 pie tells the story. It says that when you hand a restaurant cashier $1 for your meal you have had about 45 cents worth of raw food prepared for you. The labor of preparing and serving it costs 25 cents, and the landlord took another 7 cents from the restaurant operator.

The miscellaneous item embraces a variety of actual and recurrent expenses, too small to be itemized on an individual meal basis. For instance: clean floors take soap, wax and energy in the cleaning. On the average cleaning, supplies take ½ cent of our $1 pie. Clean table cloths and starched uniforms slice off another cent. Printing menus bite off another ½ cent, and so on. But why run the gamut? We know that licenses, taxes, insurance, replacements of china and silver, depreciation and other incidentals have to be paid for. Together they exceed 10 cents, so we label them "miscellaneous".

Let's get promptly to the interesting slice labeled "Light and Power". This is broken into two sections: "Light and Refrigeration" and "Cooking Cost". The tiny slice, representing 1½ cents and marked "cooking cost" is the portion we want and mean to have! If not all at once, at least we can start nibbling.

Electric cooking is the one operating tool that offers our restaurant operator an opportunity to exercise added control over his food and labor costs and so increase his profits. For instance: one cafeteria chain says that electric roasting has cut meat shrinkage 10%. Another operator says that fat savings of 15% followed his use of electric frying. These figures are modest. Because they are below the usual saving estimated we can accept them as conservative figures. Other estimates on fat savings exceed 30%. But any saving is a good one and it pays to be conservative. One of the delights of a salesman's life comes when he


Where the Restaurant Dollar Goes
FOOD 45¢
Electric Cooking cuts shrinkage—prevents spoilage—makes good food taste better
PROFIT 9¢
Modern Electric Cooking will increase the size of this item
COOKING COST 1½¢
LIGHT-REFRIG-2¢
MISCELLANEOUS 10½¢
RENT 7¢
LABOR 25¢
Even inexperienced help can operate Automatic Electric Cooking Equipment

COOKING COST—the tiny 1½¢ slice of the restaurant dollar—is the portion we want and mean to have!

Gone ...

YOU'VE SEEN IT HAPPEN. A severe winter, the sudden onslaught of rain and sleet becoming heavy ice, and then—pole failure at the groundline!

BUT THIS CAN BE PREVENTED. A full length Pentachlorophenol treatment is excellent protection against such an untimely occurrence. And with Pentachlorophenol you get a clean treatment—it leaves wood nonsticky and easy to handle.

THROUGHOUT THE COUNTRY users are requesting Pentachlorophenol-treated poles, crossarms and lumber. For *effective* and *lasting* protection specify the Pentachlorophenol treatment!

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

DOW

CHEMICALS INDISPENSABLE
TO INDUSTRY AND AGRICULTURE

I DARE YOU to explain demand charge to your barber

hears a user say that savings exceed the salesman's estimate.

These savings—and others like them spring from accurate heat control, the unique advantage shared by all electric cooking equipment. Consider a fuel so accurately controlled that it can heat a pad so gently that it can be placed against a baby's skin —yet will melt steel with perfect control through all temperature scales.

Translate this controllability into cooking techniques and it's easy to understand why modern chefs prefer electric cooking just as machinists appreciate precision machine tools. It enhances his skill and assures results. Results breed enthusiasm in both the user and in the salesman.

Enthusiasm is Contagious

Little successful sales experiences, piled one on another, will lead your salesman's enthusiasm for electric cooking to new heights. Enthusiasm —and I dare you to look it up in a good dictionary—has sold more applications of commercial electric cooking than all the demand charts and rate studies ever offered. After all, enthusiasm is the *sine qua non* of any good salesman. It is contagious. It is the one fever that leaves a man better than it found him.

However, a utility salesman does need an excellent grounding in his rate structure—although electric cooking is not sold on the cost of operation today. This sounds paradoxical but it isn't. A salesman's ability to give concise rate information is a priceless ingredient in building customer confidence, because when a salesman knows his own business intimately, the customer assumes that he also knows where electricity fits the food service business.

Rare as a pastor in a night club is the salesman who can explain his rates in parables, so simple that even the dishwasher can grasp the facts.

I dare you, Mr. Utility Executive, to explain demand—to sell the justice of your demand charge—to your barber. A short prayer will steady the nerves as the razor strokes the adams apple.

Today, electric rates are less a factor in selling electric cooking than ever before. The number and variety of successful installations exert a constant pressure on your prospects. Savings in raw (and high priced) foods, reduced shrinkage of meats, economy in frying—each outweigh the cooking cost.

A Typical Example

We can prove it. Take as an example a restaurant operator that uses 50 lb. of fat a week. He buys more than 200 lb a month—when he can get it. If we can justify a 15% saving by switching to electric frying we are offering a saving in fat of about 30 lb at today's prices of 35 cents a pound. This saving—and we are assuming a 25 lb kettle or smaller—amounts to $10. This will pay the electric operating cost easily. The advantages of doing more profitable frying with less fat must be estimated. Lower power rates stimulate acceptance but do not cause it. The first requisite is better food more profitably served. Once that point is gained, the rate need not be competitive with any fuel now in use that does not offer all these advantages.

Knowledge gained by actually cooking with the electrical equipment is beyond price. Once you have electrically broiled—and eaten—a juicy sirloin steak there is no one who can unsell you on the advantages of electric broiling. Fry yourself a batch of crisp, golden French-fried potatoes and wield a saltceller over them and you have old *solanus turberose* in his glory. Eat them and then let your gastric juices seep deep into your memory. Let your taste sensations sell your next fry kettle.

Manufacturers' catalogs give your prospects operating data and characteristics. Particularly valuable when space becomes a factor, your catalog gives dimensions. When performance and capacity are questioned it will give you the pounds per hr or average cooking time. With these the selection of the proper-sized equipment becomes a simple problem in division or multiplication.

RARE as a pastor in a night club is a salesman who can explain his rates so a dishwasher can understand

Properly sized equipment will keep you free from high bill complaints for, although spare capacity is often desirable, it is difficult to justify if it brings in its wake a wasteful, recurrent, high cost of operation.

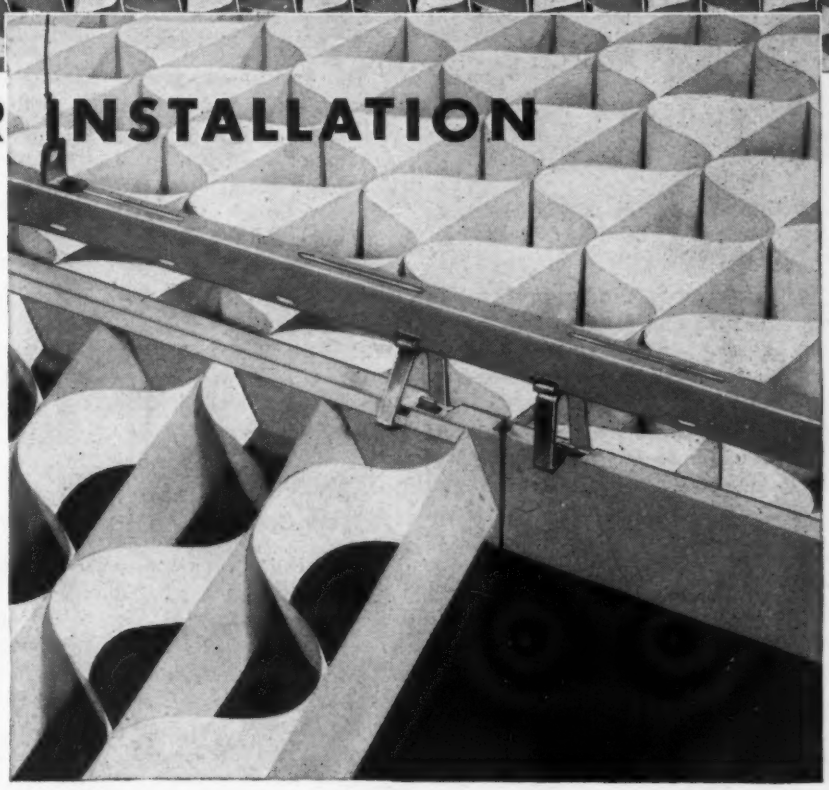
Available to the salesman eager to increase his knowledge of the food service industry is a variety of publications by government, meat packers, processors of frying oils, equipment manufacturers and others interested in volume cooking. Restaurant publications and electrical publications frequently carry articles on installations and other pertinent information.

Accumulating a comprehensive file of such data is a time-consuming job but only by such means can you build your library of facts. Such factual information bulwarked by experience is the basis for becoming an expert. An expert is a man who knows his facts, can quote his authorities and can impart his information.

The field of mediocrity is crowded and mediocrity cannot succeed in electrical cooking promotion. Start now—be an expert—your customers deserve your best—have a best to offer to them.

FEDERAL Cell-Ceil*

for EASIER INSTALLATION



Quicker SALES

The simple sturdy hanging mechanism for Cell-Ceil* makes installation easy for the contractor — gives the building owner quick results. It's easier to sell Cell-Ceil for quick completion of jobs can be assured.

Better PROFITS

Lighting profits now from wall to wall! Cell-Ceil installations, easier to sell, easier to install, will add real volume to your lighting sales. Unprecedented interest being displayed by building owners in this new all steel louvre unit prove it to be one of the major steps in the history of lighting. This aroused interest means real profits to you.

Cell-Ceil comes in harmonious decorator colors. It is made of Acme Galva-Bond Steel**, that offers protection against loss of color or corrosion. These Cell-Ceil sections cannot warp. They are lightweight sections, suspended from overhead, simplifying installation in new construction or remodeling. All sections match perfectly . . . give continuous one-piece look . . . hide ceiling pipes —sprinkler heads—ventilating ducts . . . yet provide easy access for relamping and cleaning.

Architects, designers, and building interests are being told about Cell-Ceil *every month* in:

Architectural Forum	Progressive Architecture
Architectural Record	Interiors

We suggest you mail in the coupon for our Cell-Ceil Technical Bulletin on installation techniques.

*Trade Mark applied for.
**T.R. Acme Steel Co.

FEDERAL ENTERPRISES, INC.
Formerly Federal Electric Company, Inc.
8700 SOUTH STATE STREET CHICAGO, ILL.

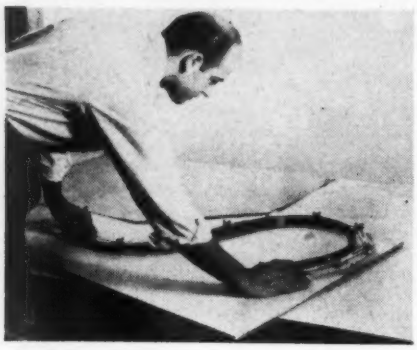
COUPON

Dept. CCT-6
Federal Enterprises, Inc.
8700 S. State St., Chicago 19, Ill.

Please send your Cell-Ceil Technical Bulletin on installation techniques.

NAME_____ POSITION_____
FIRM_____
ADDRESS_____
CITY_____ ZONE____ STATE_____

NEW EQUIPMENT



Template

A FLEXIBLE TEMPLATE to save time in curve plotting and drawing and in template making is made available by Flexible Template Co, 4900 Wynnefield Ave, Philadelphia 31, Pa.

The device has a 1¼-in. spring steel face with aluminum posts and a series of locking bars. It can be set and locked to any desired shape and transferred anywhere for construction or checking purposes. By loosening wing nuts, the template springs back to original position, ready for re-use.

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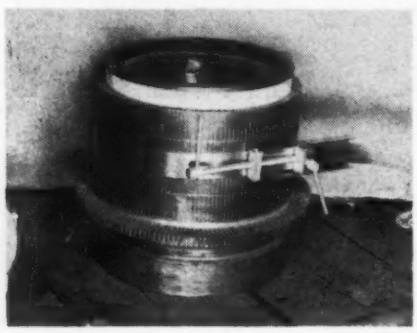


Band Type Clamp

DESIGNED FOR USE where a wrap-around clamp action is required, a multi-purpose clamp is being produced by Marman Products Co, Inc, 940 W. Florence Ave, Inglewood, Calif. It can be used in servicing large armatures and commutators. Wire banding is eliminated, it is reported.

The clamp consists of an interchangeable, stainless steel strap furnished in 1½ to 2-in. width of any desired length, square swivel assembly and take-up and locking screws of cold-rolled steel. Pressure can be instantly released by backing off locking screw one-half turn.

Insulation Tester

AN ADDITION to the line of insulation testing instruments is the "Minor" Megohmer announced by Herman H. Sticht Co, Inc, 27 Park Place, New York 7, N. Y.

The instrument is the hand-crank type, having a d-c generator with a 500-v d-c output. Measuring system is the ohmmeter cross coil type, giving deadbeat direct readings independent of generator speed. Scale range is 0-50 megohms and infinity.

Features of the instrument are its light weight, 3 lbs; small size, 5⅞x 3¾x3½ in.; and portability. Furnishings are a walnut bakelite case, leather carrying case, 6-ft test leads, and 50 megographs for recording resistance measurements.

•

Rectifiers

FOR HEAVY-DUTY industrial applications, a line of regulated rectifiers is offered by Industrial Electronics and Transformer Co, 1801 East Slauson Ave, Los Angeles 11, Calif. The rectifiers can be furnished with either electronic control for fast response or magnetic amplifier control for vacuum tube elimination. Both types are stated to be fully automatic.

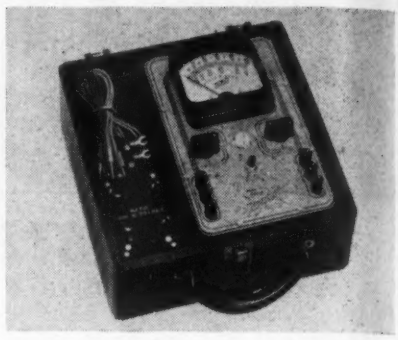
Standard models are available in current ranges from 5 to 10,000 amp and voltage ranges from 10 to 500v. Voltage regulation is reported obtainable to plus or minus 0.5% from no load to full load with a 10% change in supply line voltage. The d-c ripple may be reduced to 0.01%. Recovery time under severe load changes is claimed to be a fraction of a second.

Some applications of the regulated rectifiers are: large automatic platers, central d-c power system supplies, motion picture sound systems.

•

Volt-Ampere Wattmeter

MODEL 900B volt-ampere wattmeter is designed for testing all a-c appliances from clocks to electric ranges. It incorporates a current transformer for additional ranges of 5000 and 10,000 w, and 65 and 130 amp. The meter is manufactured by Hickok Electrical



Instrument Co, 10572 Dupont Ave, Cleveland 8, Ohio.

Appliances are tested for power consumption under actual use conditions, it is stated. A neon lamp connected between line and load binding posts can be used to test for shorts in power circuits. The instrument is mounted in a portable carrying case.

The scale ranges are: a-c watts—0-100-500-1000-2000 (5,000-10,000 extended range with C-105 current transformer); amperes—0-1.3-6.5-13-26-65-130; volts—0-130-260; milliamperes—0-260.

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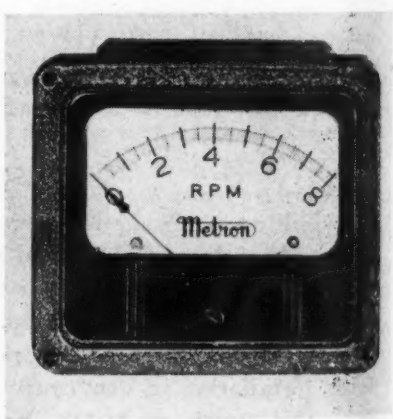
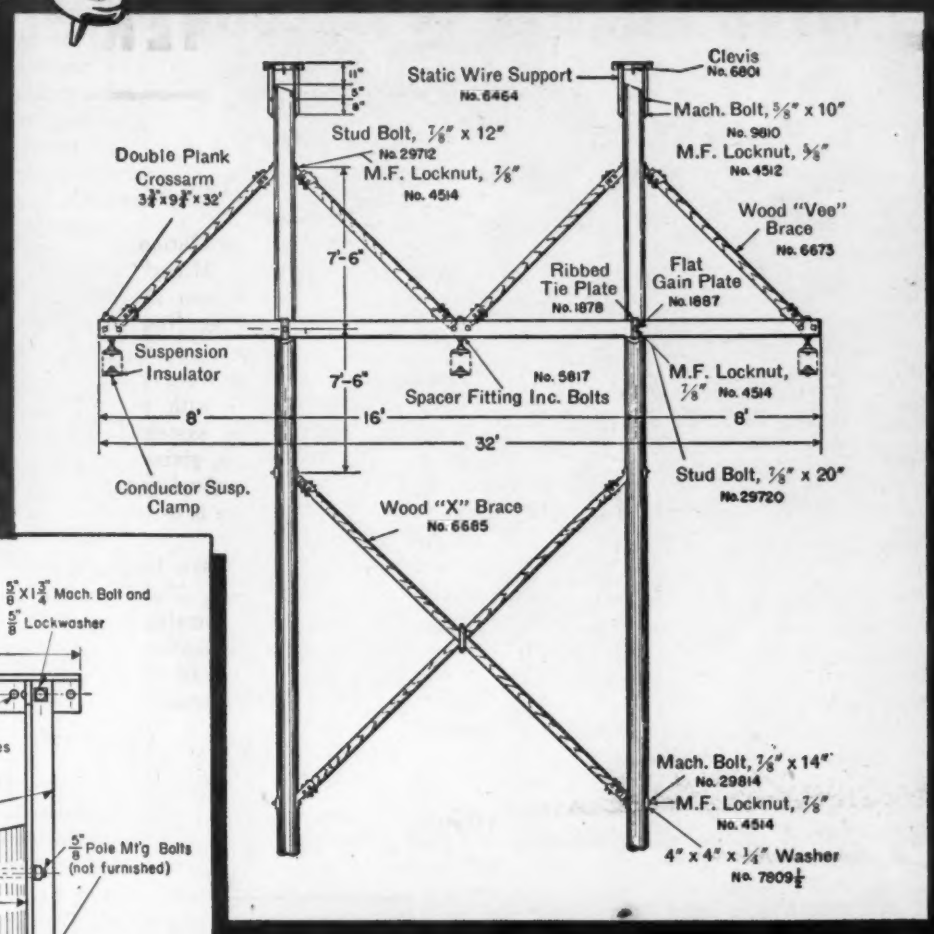
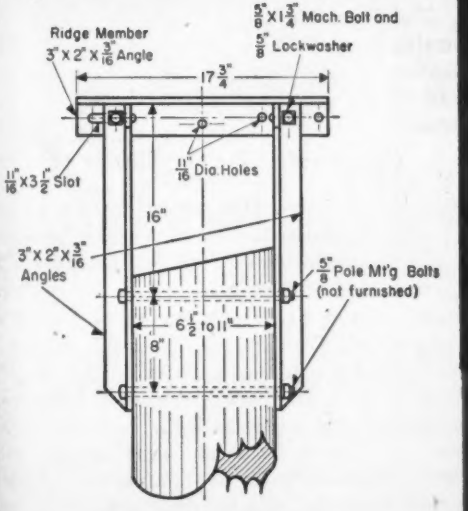


Tachometer Indicator

A NEW UNIVERSAL single-range indicator type 43 has been developed for use with any tachometer heads manufactured by Metron Instrument Co, 432 Lincoln St, Denver 9, Colo. The meter is shock mounted in sponge rubber. The aluminum housing is designed to provide flush switchboard mounting from the front or bracket mounting from the bottom.

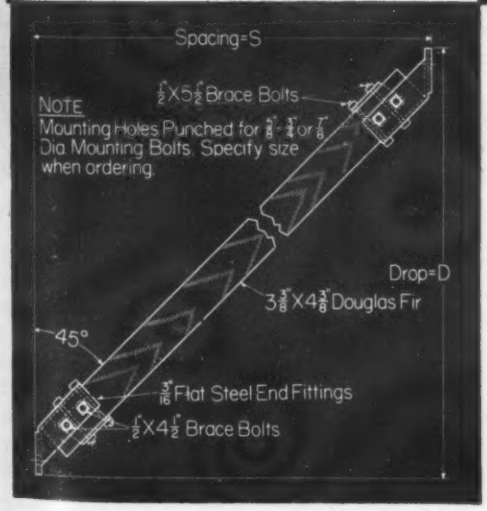
Electrical head connections are made to terminals on the rear surface. Also on the rear is a calibration adjustment. This adjustment is ordinarily sealed by





Static Wire Support
No. 6464

Typical Tangent Structure by HUBBARD


Spacing=S
NOTE
Mounting Holes Punched for 7/8" or 1" Dia. Mounting Bolts. Specify size when ordering.
5/8" X 5 1/2" Brace Bolts
Drop=D
3 3/8" X 4 3/8" Douglas Fir
45°
3/16" Flat Steel End Fittings
1/2" X 4 1/2" Brace Bolts

Hubbard "Vee" Brace
No. 6673

The H-Frame shown above consists basically of two poles of proper height and classification for 69 to 161 KV construction to which are attached two 3¾" x 9¾" x 32-foot Fir Cross Arms. Poles are slab-gained to a thickness of 7½-inches so that factory-assembled crossarms may be used. A No. 6464 Static Wire Support is mounted on each pole-top and No. 6673 Vee Braces are used to give added strength to the structure. The No. 5817 Steel Spacer Fittings serve a multiple purpose. They space the plank arms, provide a mounting point for the Vee Braces and are the points of suspension for the Insulator strings. No. 6685 Cross Brace is used to give transverse strength to the structure.

For detailed bill of materials, see your Hubbard representative or write to Hubbard and Company.

HUBBARD AND COMPANY

PITTSBURGH
CHICAGO

OAKLAND,
CALIF.

North • East • South • West . . . It's Schramm

. . . doing jobs like these in Your Field

At almost every turn you need compressed air!

The check list (at right) indicates some of the many compressed air jobs to be done, all of which are accomplished easily, quickly and economically with Schramm Air Compressors.

Here's *why* you profit, as others have, by using Schramm: they're compact, lightweight, easy to start; built for rugged jobs, to provide a continuous flow of air.

Important features include 100% water cooled; mechanical intake valve; forced feed lubrication and easy, electric push-button starting.

Performance everywhere has proved Schramm Air Compressors can do any compressed air job you require. Write today for list of models and sizes.

- Rock Drilling
- Breaking Pavement
- Trench Digging
- Clay Spading
- Sheet Pile Driving
- Backfill Tamping
- Caulking Pipe Lines
- Spray Painting
- Sand Blasting
- Digging Post Holes
- Pneumatic Grease Guns
- Pneumatic Tools
- Spraying Metal
- Spraying Enamel
- Riveting
- Steel Drilling
- Wood Boring
- Scaling
- Chipping
- Caulking Boilers
- Cleaning Boiler Flues
- Cleaning Engine Generators
- Operating Air Hoists

SCHRAMM INC.

THE COMPRESSOR PEOPLE • WEST CHESTER • PENNSYLVANIA

the factory but if desired the user may use this control in the field to calibrate the indicator for specialized applications.

Large numerals, a 4-in. scale length, and heavy main calibrations are used to provide readability at a distance. Fine graduations insure accurate readings up close. Directly calibrated in any units, this indicator can measure any quantity which is actuated by speeds from 1 rpm up to 100,000 rpm.

•

General Duty Drill

A ½-IN. PORTABLE DRILL for general production and maintenance has been announced by Fred L. Stuart 33 West 42nd St, New York, N. Y. He is United States Representative for S. Wolf & Co Ltd, London W5, England. Motor is air cooled, designed to operate on 110-120 v, and is furnished with 3-wire cord having a ground lead.

Motor frame and gear box are pressure die cast. Gears are nickel chrome. Gear spindle bearings are oil impregnated porous bronze. Armature is stated to be self aligning. Side handle has trigger switch.

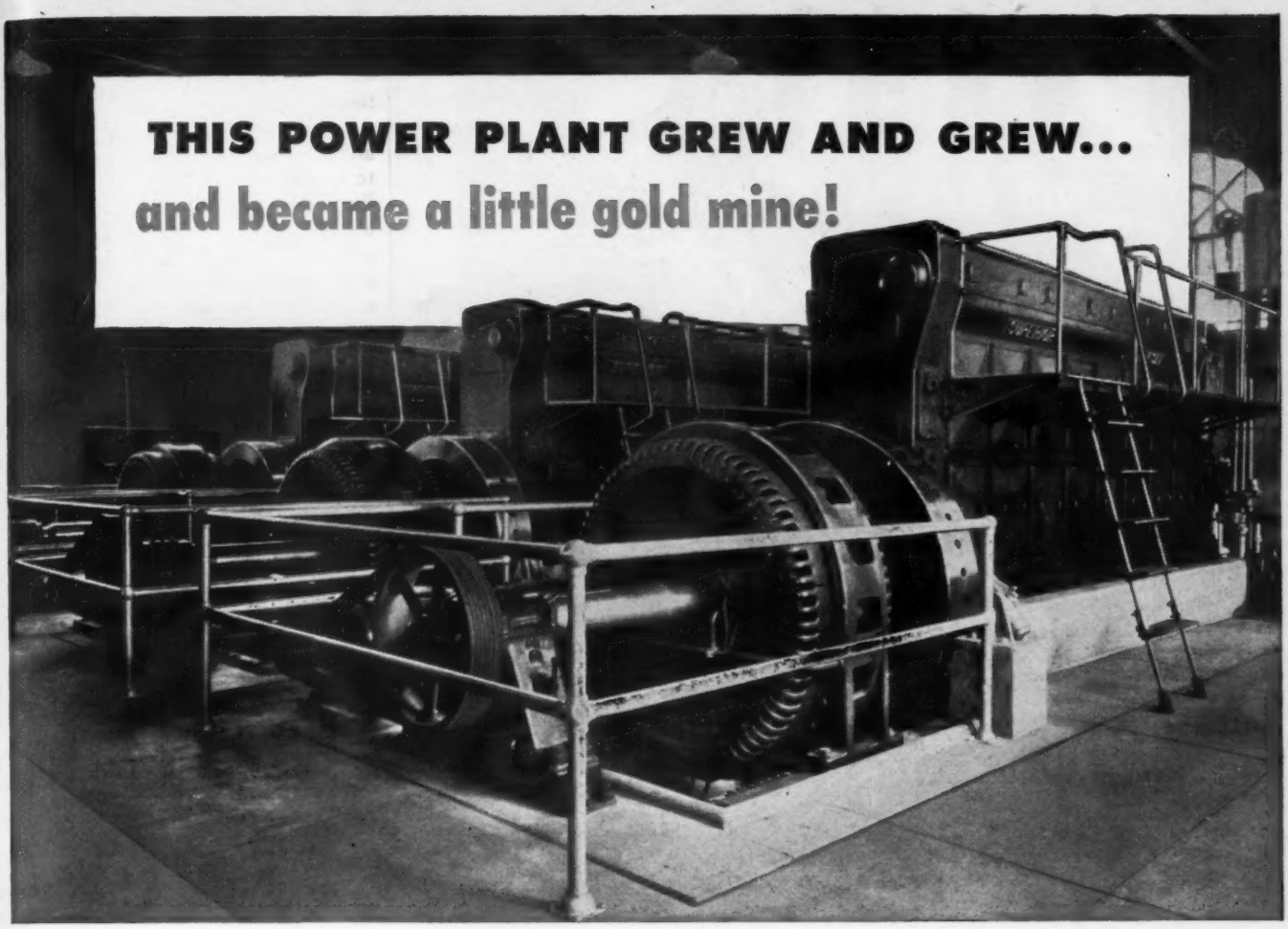
•

Cable Tydown

THIS NEW cable unit of Davis Developments, 129-07-7th Ave, College Point, N. Y., was originally designed to hold engines, generators, steel units and heavy cases in cargo planes. Because of the new unit's flexibility, strength and ease of handling it has been found to be acceptable for use in many other fields.

The unit is made in three sizes, in strengths ranging from 1,000 to 24,500 lb. The strength of the gear is equal to the strength of the cable that is used in the unit. The unit length is adjustable from the length of the lever arm to the length of the cable used in the unit. The small unit works from one to twelve feet. The hooks vary in size and strength with the cable

THIS POWER PLANT GREW AND GREW...
and became a little gold mine!



In 1939 an Arkansas town plunged itself into a $240,000 debt to build a central power plant equipped with three, 8 cylinder 620 hp. Superior Diesels.

This plant proved to be a gold mine.

The demand for electrical power increased so rapidly that during the first five years the plant paid off the debt—provided free street lighting —cut consumer rates—and created a cash reserve! As a result of this performance, two additional 1200 hp. Superior Diesel Engines have been added to increase the plant's capacity.

Hundreds of other communities throughout the country are benefiting by the dependability and economy provided by Superior Diesels. These big, husky engines are used for water supply systems, sewage disposal plants, airport lighting and for many other vital services.

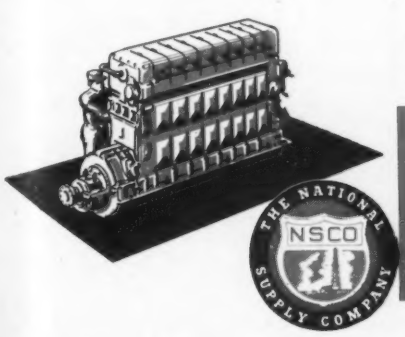
Superior Diesels are made in supercharged and non-supercharged models that range from 170 to 1500 horsepower. One of our field engineers will be glad to point out the advantages these engines have for your community.

PUSH-BUTTON DUAL FUEL

A Superior Feature

JUST PRESS A BUTTON TO BURN YOUR CHOICE OF FUEL

Superior is the first and only Diesel with push-button control of fuel selection that permits you to switch from oil to gas; or gas to oil instantly —with the flick of a finger.



SUPERIOR ENGINE DIVISION OF
THE NATIONAL SUPPLY COMPANY
Plant and General Sales Office: Springfield, Ohio

Superior DIESEL

Only Superior Diesel Engines Give You Superior Features

KLEINS

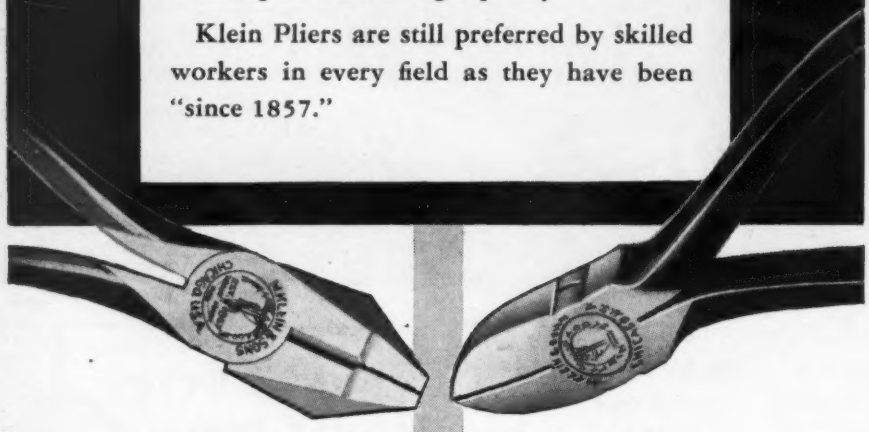
FOR MEN WHO WANT

the Best

• Ever since the first communication and power lines were strung, Klein Pliers have been the favorite tools of electrical workers.

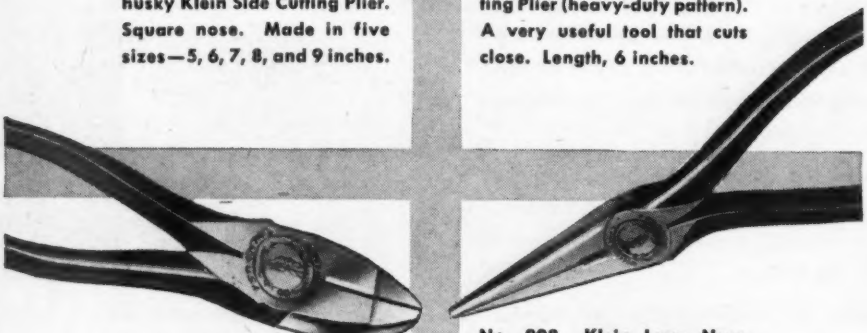
Today, Klein Pliers are made with the same exacting care that has won these tools their reputation for high quality.

Klein Pliers are still preferred by skilled workers in every field as they have been "since 1857."



No. 201. Original pattern husky Klein Side Cutting Plier. Square nose. Made in five sizes—5, 6, 7, 8, and 9 inches.

No. 242. Klein Oblique Cutting Plier (heavy-duty pattern). A very useful tool that cuts close. Length, 6 inches.



No. 201 NE. The famous "streamlined" Klein Side Cutting Plier. Made in five sizes —5, 6, 7, 8, and 9 inches.

No. 203. Klein Long Nose Plier. Long reach of jaws permits getting into difficult places. Made in 6 and 7-inch sizes.

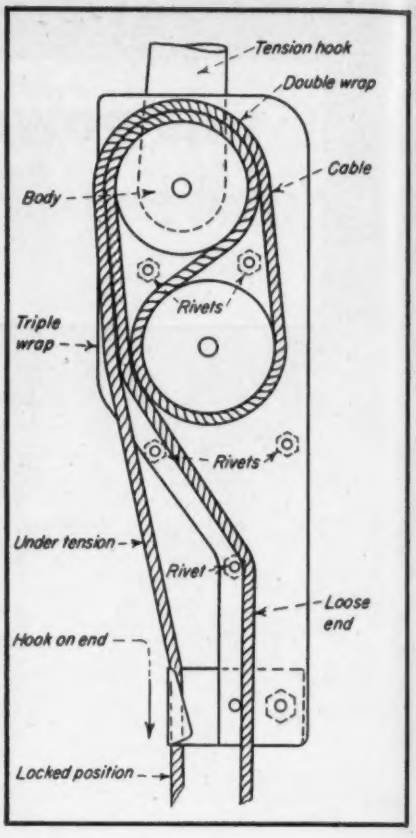
The Klein Pocket Tool Guide, showing the Klein line and containing useful tool information, will be mailed on request.

Established 1857

Mathias KLEIN & Sons

Established 1857 — Chicago, Ill., U.S.A.

3200 BELMONT AVE. CHICAGO 18, ILL.



size and the unit to cable sizes run in thirty seconds of the inch. The unit is made in two types; one type with a short piece of cable on the unit body, and on the second type the hook is attached directly to body. Hooks may be replaced with shackles or other types of cable hardware for permanent use.

•

Ribbon Type Anode

A MAGNESIUM ribbon anode for protecting buried metal structures from corrosion by means of cathodic protection is known as Galvo-Line. This new material has been developed by the laboratories of the Dow Chemical Co, Midland, Mich.

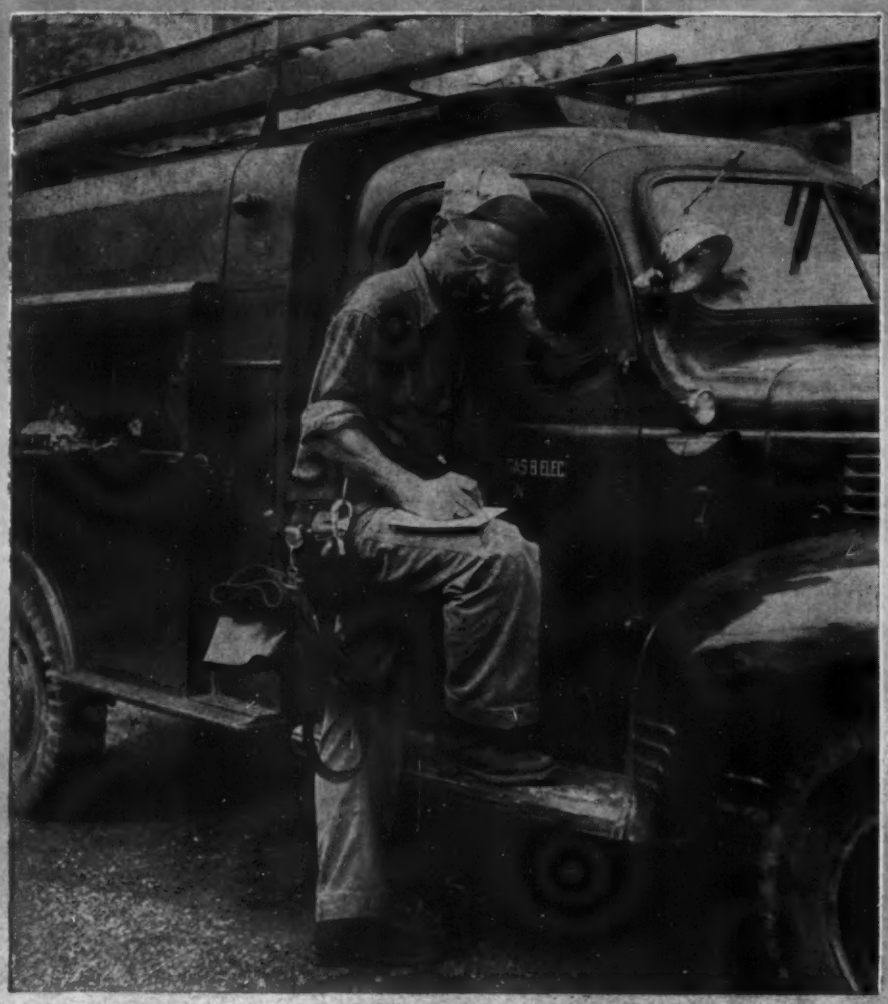
The new anode is intended for use in high resistivity soils where cast anodes may not be practical because of their low current output.

Galvo-Line has a cross-section of $\frac{3}{8}$ in. by $\frac{3}{4}$ in. and contains a core of iron wire to facilitate making permanent electrical connections and to prevent possible segregation. The anode ribbon is wound and stored on reels and is available in standard lengths of 1000, 2000 and 5000 ft.

•

Motor Capacitor

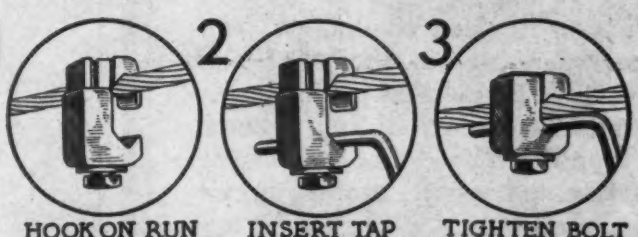
A NEW PYRANOL motor capacitor, designed to withstand the same physical treatment as the motor itself, has been



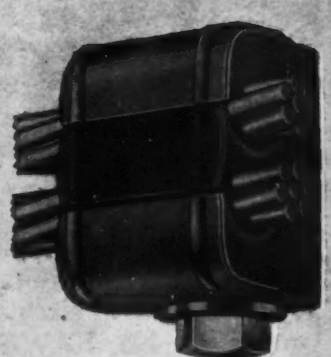
"...and more Fargo "bugs."

For years linemen have requested
FARGO CONNECTORS
because they are

EASY TO USE



STANDARD
5000 Series
AVAILABLE IN SIZES
FROM #8
TO 1,000,000 CM
(Approved by Underwriters' Laboratories, Inc.)



HEAVY DUTY
7000 Series
AVAILABLE IN SIZES
FROM #2 Stranded
to 1,000,000 CM

SAFER and QUICKER to install
FREE from TROUBLES after installation

"---grips like a vise."

Distributed by
LINE MATERIAL COMPANY
Milwaukee, Wisconsin

FARGO

Manufactured by
FARGO MFG. COMPANY, INC.
Poughkeepsie, N. Y.

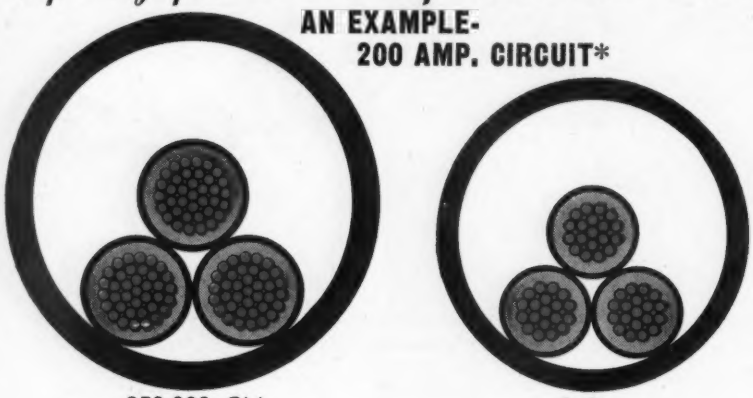
LM

CRESCENT

ENDURITE
Type RH

Gives Greater Current Carrying Capacity per Dollar of Installed Cost

AN EXAMPLE-
200 AMP. CIRCUIT*



250,000 CM
TYPE R
Requires 2½" Conduit Maximum permissible operating temperature 60°C.

3/0
TYPE RH
Requires 2" Conduit. Maximum permissible operating temperature 75°C.

The superior heat resistant characteristics of CRESCENT ENDURITE INSULATION with its higher permissible operating temperature and therefore greater current carrying capacity, permits the use of a smaller size of conductor, and in most cases smaller size of conduit at less cost than would be required for Type R Wire for the same load.

For light loads requiring small sized conductors, Voltage Drop is the determining factor in choice of wire size. Usually in sizes No. 6 AWG and heavier for power circuits or No. 1 AWG and heavier for lighting circuits, CRESCENT ENDURITE Type RH Wire & Cable gives the lowest installed cost-per-ampere of useful circuit capacity.

In Accordance With 1947 National Electrical Code

CRESCENT

WIRE and CABLE

CRESCENT INSULATED WIRE & CABLE CO.
TRENTON, NEW JERSEY

announced by the Transformer and Allied Products Divisions of the General Electric Co. Available from stock in all popular ratings, the new capacitor is enclosed in 10-gage steel tubing.

Bushings are of silicone, the new rubber-like material that seals permanently by compression without gaskets or stickers, and that is impervious to oils, acids, and alkalies. The steel mounting bracket is spot-welded to the capacitor enclosure.

Long Flamenol leads are protected by insulating eyelets where they pass through the enclosure, and are unaffected by baking heat, oil, water, or mild acids.

•

Rectifier Tube

A FAST DEIONIZING, temperature-free, grid controlled rectifier tube type 5528 (C6L) has been developed by Electrons Inc, 127 Sussex Ave, Newark, N. J.

This tube is designed for servo motor control or inverter applications which must operate up to 800 cycles. Electrical characteristics are: 60-sec heating time; 500 peak inverse volts; 6.4 amp steady d-c current; and 77 peak amp.

•

Immersion Test Unit

A NEW dual liquid immersion testing unit model C-119 has been announced by K & H Industrial Products, Inc, 459 Morgan Ave, Akron 11, Ohio. It is designed for use in testing, calibrating and regulating thermometers, thermocouples, pyrometers, and other temperature indicating and control devices.

This new unit of twin tank design has an operating range of from 70 to 700 F (depending upon liquid used), and each tank is equipped with individual temperature controls and liquid agitators. The use of two tanks facilitates double checking of each instrument being tested or calibrated at two different temperatures to determine percentage of accuracy.

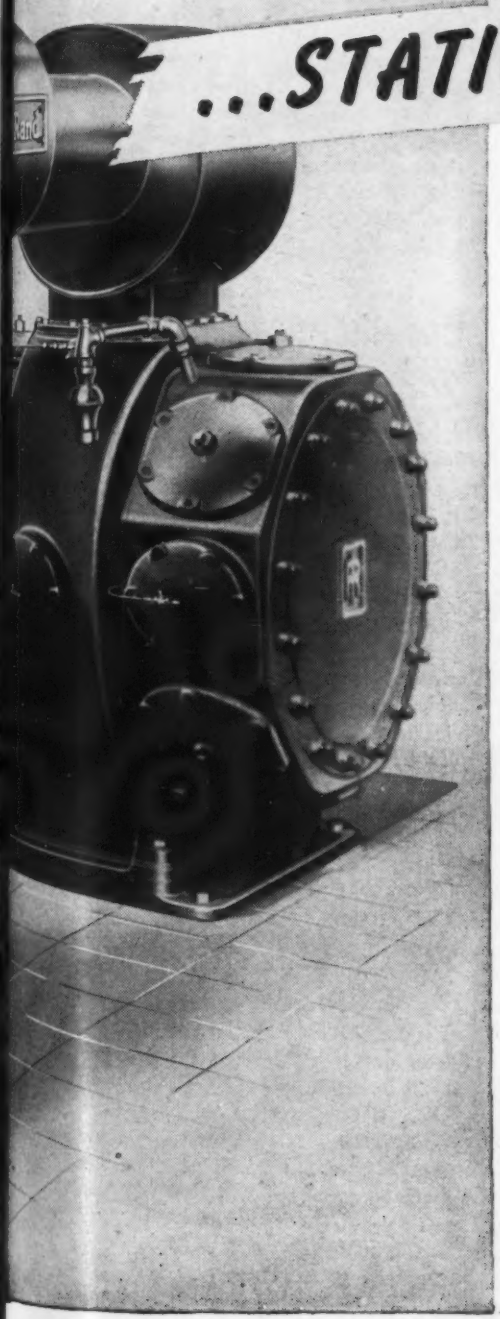
Cabinet housing is insulated with 3-in. thick magnesia block. Motor powered

. for Air Compressors

and HIGH PRESSURE

-STAGE and MULTIPLE-STAGE

...STATIONARY and PORTABLE



Regardless of size or classification, assured, uninterrupted performance of air compressors depends largely on lubrication. High stability and oxidation resistance are necessary qualities of a compressor lubricant to protect against the problems of carbon formation and sticking valves.

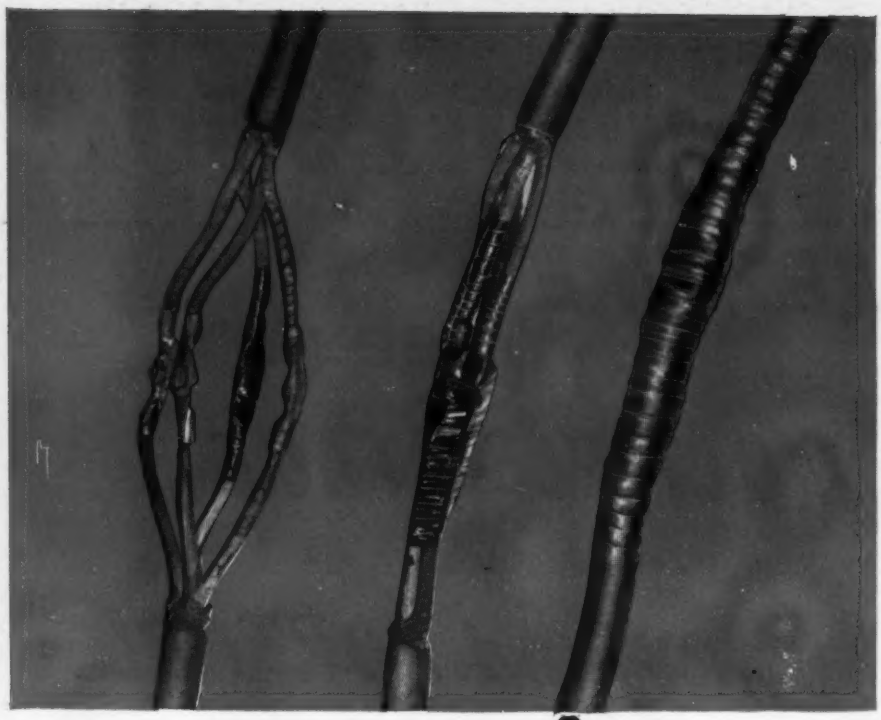
Every grade of Sinclair RUBILENE is always fully refined to meet these requirements. Whether of low-viscosity or heavy body, RUBILENE is always top quality, always uniform.

Write for expert consultation on the use of rugged RUBILENE for all compressors.

SINCLAIR

INDUSTRIAL OILS

FOR FULL INFORMATION OR LUBRICATION COUNSEL WRITE SINCLAIR REFINING COMPANY, 630 FIFTH AVE., NEW YORK 20, N. Y.



PROTECTION FOR POWER CABLES THAT DRAG IN THE IRON MUD OF MESABI

Splicing the rubber covered power cables of electrically powered dragline excavators, cranes, etc., used in open pit iron mining on the Mesabi Range, has been greatly simplified and accelerated by using No. 33 "SCOTCH" Electrical Tape with Vinylite backing to wrap the individual conductors; using 2 to 3 wraps. Over this is applied a buildup of No. 24 "SCOTCH" Neoprene Tape to approximate the thickness of the cable. Then the entire splice is given a strong outside wrap of No. 33 "SCOTCH" Electrical Tape for abrasion resistance, moisture proofing and additional electrical insulation.

One of the largest iron mining companies on the Mesabi Range, as well as numerous utility companies around the country, find that No. 33 "SCOTCH" Electrical Tape saves time by facilitating field repairs that are thoroughly efficient and extremely tough and durable.

In shaft mines where extreme conditions of moisture and dirt prevail, the waterproof, abrasion resistant qualities of No. 33 "SCOTCH" Electrical Tape make it possible to produce efficient splices without the use of a vulcanizing machine.

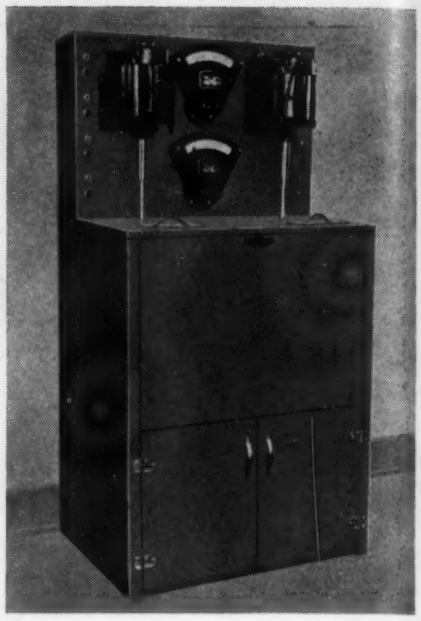
All this, of course, cuts maintenance costs and saves a lot of money. Write today for a sample roll and complete information.

No. 33

SCOTCH BRAND Electrical TAPE

ANOTHER 3M COMPANY PRODUCT

Made in U.S.A. by MINNESOTA MINING & MFG. CO. St. Paul 6, Minn.



agitators operate on 110-v a-c, and heating elements on 220-v a-c. Bristol temperature control instruments limit liquid temperatures to within plus or minus 1% of temperature setting throughout operating range.

Floor model shown in illustration stands 54½ in. high, is 28 in. wide and 20 in. deep.

•

Capacitor Type Filter

A CAPACITOR TYPE filter, designated type NF-10135 and rated at 250 v a-c, was recently developed by Radio Interference Laboratories of Cornell-Dubilier Electric Corp, South Plainfield, N. J. It is reported to be effective when connected across the power line of both hot and cold cathode fluorescent lamps. Other uses are with electrical appliances, such as fans, motors, drills and vacuum cleaners. Its low impedance circuit is said to assure maximum radio noise reduction at all frequencies.

The type NF-10135 filter is ⅝ in. in dia by 2 in. in length, with 6½ in. insulated wire leads. It is wax sealed to withstand humid service conditions, and the sturdy tubular case has a convenient mounting bracket.

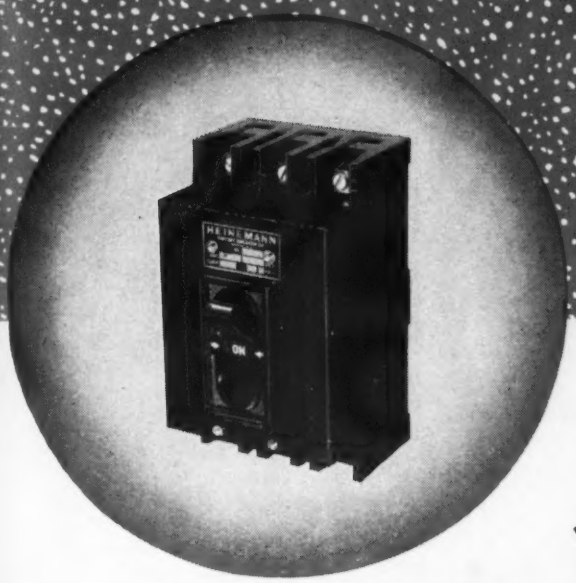
•

Welder Controller

A COMBINATION welder controller designated Class 8992 Type BBG-1 has been developed by the Square D Co, 4041 N. Richards St, Milwaukee 12, Wis. It is to provide electrical control for a small foot or motor operated resistance welding machine. The single enclosure contains a NEMA 1A pneumatic weld timer, a size 1W, 100-amp magnetic welder contactor, a control transformer and interwiring.

For operator safety the initiating

Designed to Protect Fine Equipment!



HEINEMANN MAGNETIC CIRCUIT BREAKERS

prevent damage from possible excess current or short circuit in this Meter Testing Equipment.

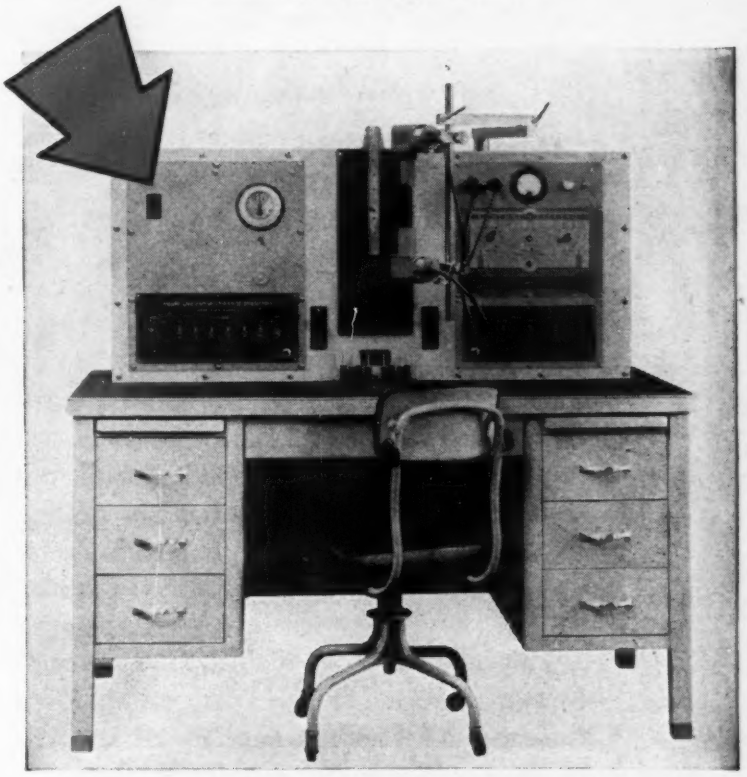
ELECTRICAL FACILITIES, Inc. *knows from experience,* that the particular circuit breaker illustrated here (the 3 Pole, All Purpose Breaker) is sure protection against any dangerous increase of current from short circuit or any other cause.

Says J. T. Pringle, Sales Engineer for Electrical Facilities, "We use Heinemann Circuit Breakers in the supply line on several of our other products, and our customers seem to be well pleased with this feature."

Heinemann Circuit Breakers are *entirely magnetic.* A magnetic-hydraulic, hermetically sealed time-delay unit prevents the breaker from tripping on temporary or harmless excess current.

Find out how HEINEMANN CIRCUIT BREAKERS add to your product's life, safety and sales Appeal.

WRITE US!



Knopp Type TE-5 Watthour Meter Testing Equipment manufactured by ELECTRICAL FACILITIES, INC., Oakland, California.

HEINEMANN ELECTRIC COMPANY

ESTABLISHED 1888

103 PLUM STREET TRENTON, N. J.

It's NEW! It's NEEDED!

It's a CHAMPION *exclusive!*

—this R-40
REFLECTOR FLOOD
or SPOT LAMP
with a base
that *Stays Put!*

Here's what you have been looking for—the useful 150 watt R-40 for all sorts of flood and spot lighting—with a base that *laughs at heat, never lets go, never freezes in the socket,* actually *improves* instead of deteriorates with age.

Only CHAMPION R-40s have this new, rugged, mechanical, cementless base. Lamp dimensions are unchanged so it fits any or all of the usual recessed fixtures or bullet-shaped holders that so often get too hot for the old style lamp base and result in bulbs pulling loose, falling out or failing long before their time.

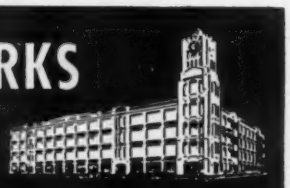
This new R-40—available only in lamps bearing the CHAMPION Diamond Mark—is the lamp to use and the lamp to sell. It opens the door to new and profitable volume.

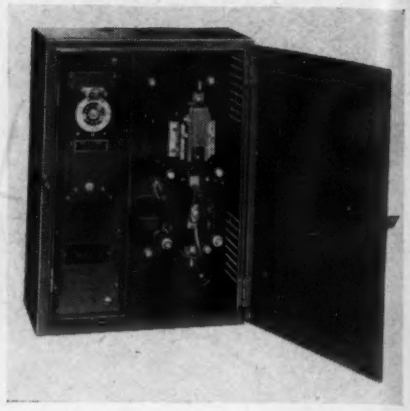
Ask your wholesaler for CHAMPION *150/RFL/M* for flood, *150/R/SP/M* for spot.

CHAMPION LAMP WORKS

Lynn, Massachusetts

A DIVISION OF CONSOLIDATED ELECTRIC LAMP CO





switch and control circuits operate at 110v isolated from the power supply. The timer is mounted on a swingout panel with the adjusting dial on the front and all of the energized parts in the rear.

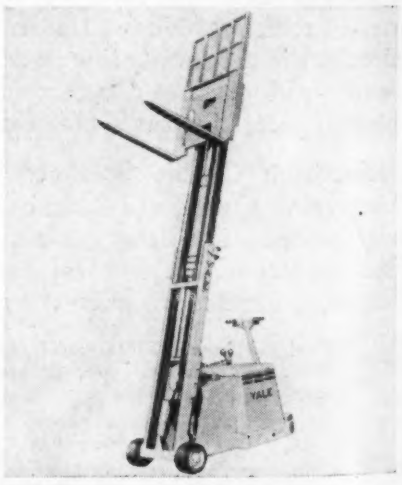
Controllers are designed to permit either common or separate control supply connections. A dual primary control transformer may be connected for 110, 220 or 440 v, 60 cycles, or for 380 v, 50 cycles.

•

Telescopic Fork Truck

A NEW 120-inch telescopic tilting-fork electric truck has been announced by the Materials Handling Division of The Yale & Towne Mfg Co, 4530 Tacony St, Philadelphia 24, Pa. The new Worksaver has a capacity of 3000 lb. Dimensions are 33 in. wide by 64 in. long. Convenient where aisle space is narrow and freight cars must be entered; also to service overhead cable.

A high reach of 120 in. combined



with a low lowered clearance of 83 in. is accomplished by means of a ram-within-a-ram. When an outer hydraulic piston has fully extended upward, an inner one begins to extend downward, doubling the lift available.

The truck travels at 2 mph under full load, lifts 8 fpm with 2500-lb load, and tilts a full 18 deg in 10 sec. Total weight of the truck, including a 19-plate bat-

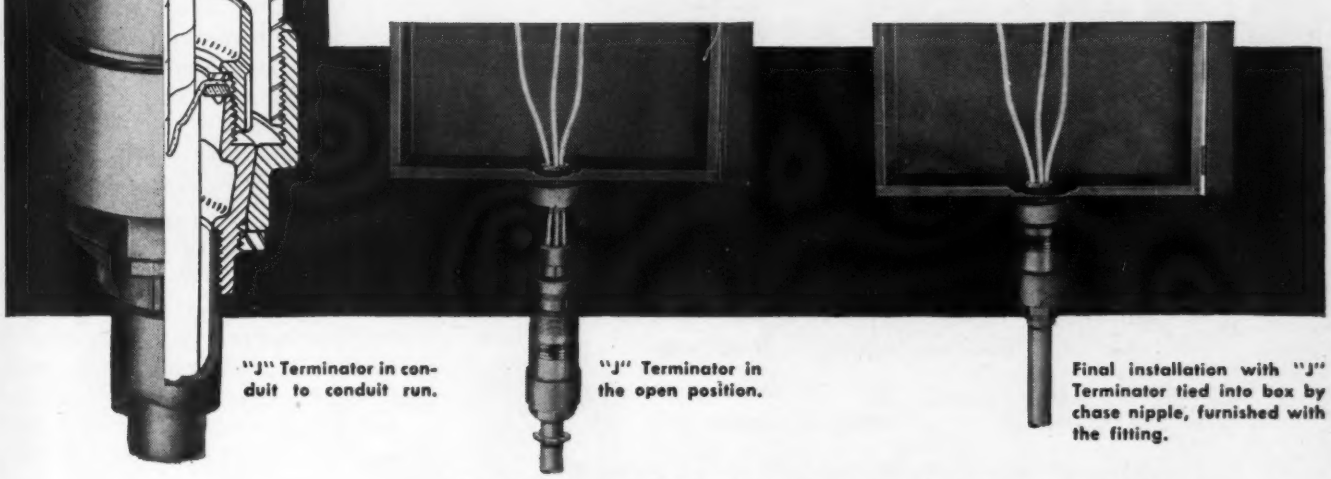
Save Money!

SEAL—TERMINATE—INSPECT
without disturbing other equipment

Use O.Z. "J" Terminators

The special collapsible design feature of O.Z. "J" Terminators saves time and effort in electrical installations . . . reduces maintenance costs. Here's how the "J" Terminator saves you money:

- **Efficiently seals and terminates conduits and cables outside cabinets.**
- **Permits subsequent inspections or current checks without circuit interruption by merely dropping sleeve.**
- **Serves as pulling and splicing chamber.**
- **Collapsible feature permits terminating conduit at enclosure, or terminating conduit and then continuing run.**



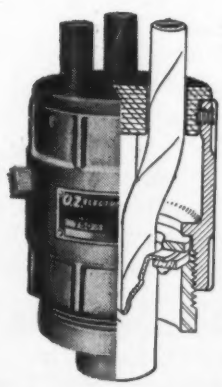
"J" Terminator in conduit to conduit run.

"J" Terminator in the open position.

Final installation with "J" Terminator tied into box by chase nipple, furnished with the fitting.

In addition to the "J", O.Z. makes a complete line of terminating potheads, compound bushings and sealing bushings for lead and rubber-covered, braided, and armored cables. With these designs, it is possible to meet all industrial requirements.

When special equipment is needed, our engineering department is prepared to cooperate with you. Write O.Z.'s Service Manager now, for a detailed catalog of electrical fittings.



TYPE "CLC" TERMINATING POTHEAD. A compact terminator designed for lead-covered cable. It seals the cable and grounds the lead sheath. Body of fitting screws directly on the conduit.

THEY'RE O.K. IF THEY'RE O.Z.

CONDUIT FITTINGS • CAST IRON BOXES • SOLDERLESS CONNECTORS
CABLE TERMINATORS • GROUNDING DEVICES • POWER CONNECTORS

O.Z. ELECTRICAL MANUFACTURING COMPANY
262 BOND STREET · BROOKLYN 7, N. Y. 4286

STOP FIRE FASTER!

ANSUL MODEL 350 A

WITH THE MASTER OF FLAME ANSUL* FIRE EXTINGUISHING EQUIPMENT

DRY CHEMICAL

FIRE EXTINGUISHERS

MORE AND BETTER FIRE PROTECTION FOR YOUR FIRE EXTINGUISHER DOLLAR

Ansul Dry Chemical Fire Extinguishers give you more protection . . . pound for pound . . . dollar for dollar . . . than any other extinguisher of comparable size.

In addition . . . Ansul Fire Extinguishers provide the best first-aid protection:

- For electrical equipment hazards . . .

TRANSFORMERS, GENERATORS, CIRCUIT BREAKERS, MOTORS, ETC.

Ansul Fire Extinguishers have the highest established ratings for effectiveness on flammable liquid fires, based on tests by nationally recognized approval agencies. The longer range stream of dry chemical is effective in winds and drafts.

After use, Ansul Dry Chemical Fire Extinguishers can be recharged "on the spot" . . . providing continuing protection . . . and annual recharging of Ansul extinguishers is NOT necessary.

Safe to use . . . non-toxic, non-corrosive, non-abrasive.

Ansul Dry Chemical Fire Extinguishers are preferred fire protection in the utilities field and for electrical equipment hazards in all industries.

Ask for your copy of file No. 204. You will receive factual data on how Ansul Dry Fire Chemical Extinguishers will cut your fire protection costs.

Listed and approved by Underwriters' Laboratories and Factory Mutual Laboratories.

Ansul Model 30

Ansul Model 20

Ansul Model 4

ANSUL CHEMICAL COMPANY
FIRE EXTINGUISHER DIVISION, MARINETTE, WISCONSIN
DISTRIBUTORS IN ALL PRINCIPAL CITIES

tery, is 3,640 lb. Though battery powered in every respect, the truck is guided by a walking operator.

MORE NEW PRODUCTS
about which you should know

Fitch, Allen and Co, 1131 Bryn Mawr Ave, Chicago 40, Ill, manufactures a **starting switch** for single-phase, split-phase, or capacitor start, 90 to 130v, 50/60-cycle, $\frac{1}{6}$ to $\frac{1}{3}$-hp motors. . . . Mitchell Mfg Co, 2525 Clybourn Ave, Chicago 14, Ill, has the new "Super-Value" commercial **fluorescent fixture,** available in two 40w and four 40w open type models with 20 gage steel channel reflector finished in baked white enamel.

B/W Controller Corp, Birmingham, Mich., developed a Hi-power **solenoid,** rated 32 lb push or pull, 100% voltage, 1¼-in. stroke, for valves located near boilers. . . . Sylvania Electric Products Inc, announces formed **metal ribbons** of nickeled steel, stainless steel, copper clad steel, inconel, copper, beryllium copper, phosphor bronze, brass and aluminum in various shapes up to $\frac{1}{4}$-in. wide. . . . Air Reduction Co, 60 E. 42nd St, New York, N. Y., is producing a manual Heliweld **300-amp holder** with molded ethyl cellulose plastic exterior for water cooling system of welding electrode.

Hexacon Electric Co, 206 W. Clay Ave, Roselle Park, N. J. announces a model P212 **soldering iron,** rated 200w, with a $\frac{1}{2}$-in. dia plug tip and replaceable elements. . . . S-A Manufacturing Co, 6440 Russell St, Detroit 11 Mich, has a Super-Expansion **anchor** for fastening conduits, fixtures, signs, etc in concrete; cap and body are assembled into one piece, made of steel and cadmium plated; load to pull a $\frac{1}{2}$-in. anchor from concrete is said to be 2300 lb. . . . Locke Inc, Box 57, Baltimore 3 Md, has a **template** containing outline drawings of outdoor type switch and bus insulators in scales from 1½-in. = 12 in. to $\frac{1}{4}$-in. = 12 in. to be placed under tracing and facilitate drawing.

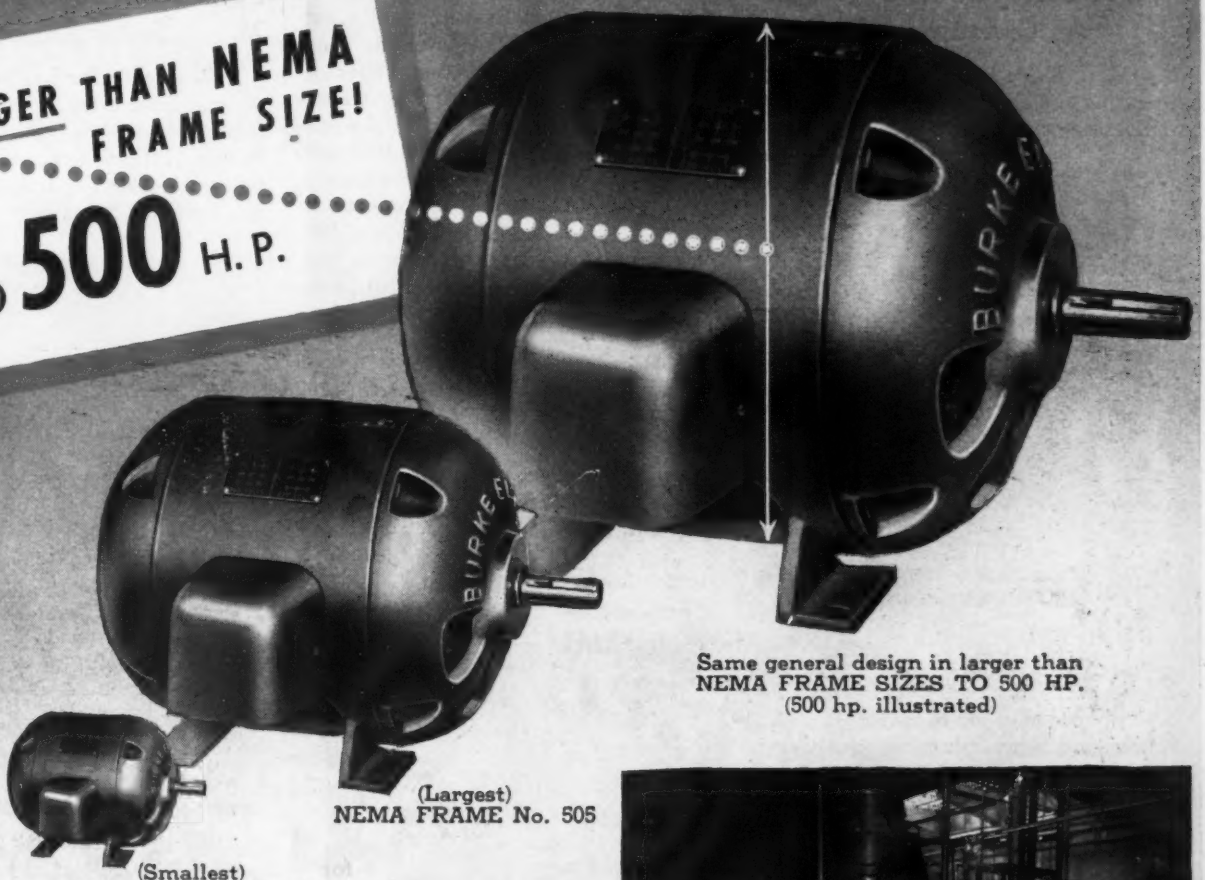
Simpson Electric Co, 5218 W. Kinzie St, Chicago 44 Ill, has a model 379 pocket-size **dry battery tester** with loading resistors and rotary switch for 12 positions to test batteries from 1.5v to 90v.

BURKE *Announces . . .*

SERIES "D" SQUIRREL CAGE INDUCTION MOTORS

LARGER THAN NEMA FRAME SIZE!

TO 500 H.P.

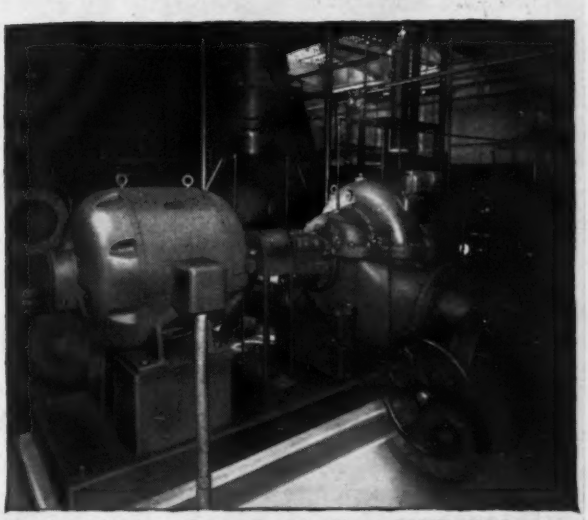


Same general design in larger than NEMA FRAME SIZES TO 500 HP. (500 hp. illustrated)

(Largest) NEMA FRAME No. 505

(Smallest) NEMA FRAME No. 203

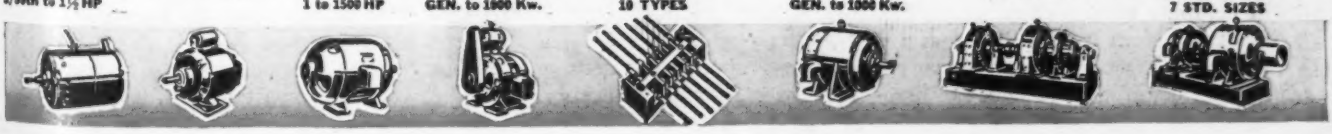
EARLY in 1947 Burke introduced its new Series "D" drip-proof design for open type motors. These are available in NEMA Standard Frames 203 thru 505. This range is shown above in the two smaller motors. Now Burke extends this streamlined design with its generous proportions, in frames larger than NEMA Standard—up to 500 hp. for all standard speeds to 3600 r. p. m. Consult with Burke for data on these high grade uniformly designed induction motors in sizes from 1/4 to 500 hp.



Burke 125 hp. Drip Proof, Type NAD, Induction Motor, driving a DeLaval 9750 g. p. m. Centrifugal Pump. Frame 681, 720 r. p. m., 2300 Volts, 3 Phase, 60 Cycle, Sleeve Bearings.

BURKE ELECTRIC COMPANY 189 W. 12th ST. ERIE, PA.

UNIVERSAL MOTORS 1/50th to 1½ HP	SINGLE PHASE MOTORS to ½ HP	INDUCTION MOTORS 1 to 1500 HP	SYNCHRONOUS MOTORS to 1500 HP GEN. to 1000 Kw.	TERMINAL BLOCKS 10 TYPES	D.C. MOTORS to 1500 HP GEN. to 1000 Kw.	M-G SETS to 1000 Kw.	HIGH CYCLE M-G SETS— 7 STD. SIZES



NEWS ABOUT PEOPLE

E. H. Krieg Joins S & W As Consulting Engineer

E. H. Krieg has been appointed consulting engineer in the Stone & Webster Engineering Corp, Boston office. He was

E. H. KRIEG

graduated from Cornell in 1922 and has since been engaged in steam plant engineering. Many advanced practices in this field are due to Mr Krieg.

From 1922 to 1925 he was with Sanderson & Porter. He was with the Electric Bond & Share Co from 1925 to 1933. Here he was responsible for the mechanical design of about 2,000,000 kw in high-pressure plants. These included several units now under construction to operate at 2,000 psi and 1,050 F with reheat at 1,000 F. Since 1933 he has been employed by American Gas & Electric, New York, lately as chief design engineer. He assumed his new duties Sept 1.

•

▶ ROY PAGE has retired as executive manager of the Omaha Public Power District. He will be succeeded by FAY E. SMITH, who has been operating manager. Mr. Page has been connected with the Omaha utility properties for 31 years. He joined the Nebraska Power Co in 1917 as assistant to the vice-president. From 1930 until the change to public ownership he was vice-president and general manager. He will continue as consultant to OPPD. FRANK J. MOYLAN, OPPD treasurer and assistant secretary, has been appointed operating manager to succeed Mr. Smith and THOMAS F. HANLEY, assistant treasurer and assistant secretary, will take over Mr Moylan's duties as general supervisor of accounting work. Both Mr Moylan and Mr Hanley started with the Omaha utility as office boys, Moylan in 1911 and Hanley in 1917. It was then the Omaha Electric Light & Power Co. SAMUEL L. COOPER was named first vice-president to succeed CHARLES D. SAUNDERS, who resigned to join a Seattle (Wash.) bank.

•

Rees Made Vice-President of Georgia Power & Light

E. C. Rees, Waycross division manager of the Georgia Power & Light Co, has been elected a vice-president of the company.

E. C. REES

Joining the company in 1925. Mr Rees was transferred to Waycross in 1931 as district manager and in 1947 was made division manager when the Waycross district was made a division.

At the time of his election as a vice-president, Mr Rees was serving as a director and assistant treasurer.

•

▶ LORIN MOORE, electrical engineer with the Bonneville Power Administration in Portland, Ore., has been transferred to the Eugene area headquarters, where he will assist Howard Elmore, district engineer. Mr Moore has been with BPA for six years.

Furber Assumes Broader Sales Responsibilities

J. Roscoe Furber has been appointed general sales manager of the Northern States Power Co, Minneapolis, and Joseph A. Busch manager of the municipal and resale department to succeed Mr Furber. These new appointments

ROSCOE FURBER

follow the recent election of Carl T. Bremicker as vice-president in charge of sales (EW, Aug 28 p 119).

Mr Furber has been connected with the power company since 1924 as student trainee, sales engineer and manager of the municipal and resale department.

Mr Busch has been identified with the company for 16 years and before going to Minneapolis he served in various capacities with the Chicago Northwestern Railway and for six years as a manufacturers' representative in Boston and Philadelphia.

•

▶ FRED S. BACON, JR, has been appointed assistant general sales manager of Rockbestos Products Corp, New Haven, Conn. Mr Bacon has assumed his new duties as assistant to H. O. Anderson, vice-president in charge of sales. In his new position, he will have immediate responsibility for general sales, advertising and sales promotion. Mr Bacon goes to Rockbestos from Westinghouse Electric Corp, where he served as manager of the central station division department at Boston. He is a

What happens to your drawings?

Is one drawing enough, or do you need copies?

Place your drawing on any one of the many Ozalid sensitized materials, feed it into the Ozalid machine, and you will have a positive (not negative) copy, dry-developed and ready to use, in a matter of seconds!

Do you change or make additions to originals?

Instead of altering or changing your original, do it on a translucent Ozalid print. You can then combine as many changed prints as you wish by putting them on transparent Ozalid film, overlaying them on a sheet of Ozalid sensitized paper, and processing!

Do you want drawings on different weight papers?

Ozalid papers are available in light, standard, and heavy weights. You can even make Ozaprints with reproductions on both sides of the sheet!

Do you want color coded drawings?

Reproduce your drawings on Ozalid papers in black, blue, red or sepia on white or tinted backgrounds. Color code prints for different departments . . . color code different circuits, dissimilar lines or symbols, etc. for greater clarity.

Do you need extra masters?

Make translucent Ozalid Intermediates directly from your tracings for use as "masters" in your printmaking. This saves the original . . . provides "masters" for different departments, branches, contractors, etc. (Ozalid Intermediates are actually better to print from than originals. They increase line density; can be made on new Ozalid plastic surfaces, impervious to stain and smudge.)

If you make drawings—or use them—Ozalid can save you time and money. Write today, and learn more about *how* Ozalid can tighten up lost time and money in your field.

ALL OZALID PRINTS PRODUCED IN SAME MANNER

★ **No tie-ups when you shift from one type of print production to another. Simply choose your Ozalid material . . . and your Ozalid Streamliner exposes and dry develops it. Standard work prints are produced in 25 seconds.**

★ **Your drawings can be up to 42 inches wide, any length. Roll stock or cut sheets can be used. (Special machines accommodate 54" wide drawings.)**

★ **You—or anyone else—can be the operator. A few hours and you're an "expert."**

★ **See *all* the Ozalid prints you make from any drawing . . . and learn full story. Mail coupon today.**

DEPT. NO. 173

OZALID A Division of General Aniline & Film Corp., Johnson City, New York

Gentlemen: Please send free copy of Ozalid Streamliner booklet illustrating all types of Ozalid prints.

Name_____ Position_____

Company_____

Address_____

_____

Ozalid in Canada—Hughes Owens Co., Ltd., Montreal

no more worries for me

...now that

KOPPERS CREOSOTE

is plentiful again!

IF you need creosote for pressure-treating wood, just send an SOS to Koppers, and we'll ship your requirements. And you'll look just as happy as the man above, because you'll get the same high-quality Koppers Creosote you've always known.

When you order Koppers Creosote (or Koppers Creosote-Coal Tar Solutions), it's important to remember that you're getting products that have decades of dependable performance behind them . . . that have established enviable records as wood preservatives everywhere.

Send in your order now. And if you want to *play safe*, ask about Koppers yearly contracts that take care of your future needs.

KOPPERS

All Standard Specifications
For All Types of Wood Preservation

KOPPERS COMPANY, INC.
Pittsburgh 19, Pa.

member of the AIEE, serving as vice-chairman of the membership committee, Northeastern district.

•

Electric Service Mfg Co Elects New Executives

Russell Kreinberg, formerly executive vice-president of the Electric Service Manufacturing Co, Philadelphia, has

R. KREINBERG

been elected to the presidency of the company following the death of the late president H. G. Lewis. Ira W. Schmidt, formerly vice-president in charge of the company's western division, has been elected vice-president and sales director.

Additional changes include E. A. Leinroth from vice-president and sales

I. W. SCHMIDT

manager to vice-president and treasurer; H. J. Graham to vice-president in charge of manufacturing, and D. B. Reeves to assistant treasurer. J. R. McFarlin has been reelected vice-president and secretary.

In the course of his long association with the company, Mr Kreinberg has advanced through the ranks of the sales department to become head of the New York office in 1927, member of the board of directors in 1937 and executive vice-president in 1946.

Mr Schmidt has also been identified

EASY with POWERSTAT

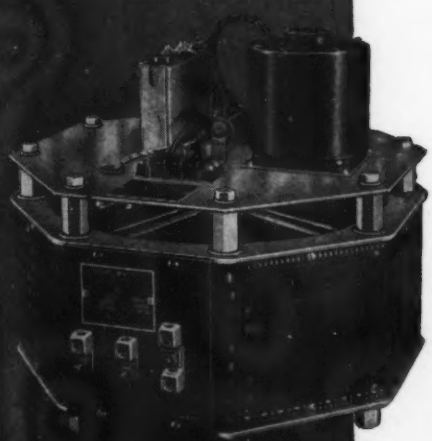
LIGHTING CONTROL EQUIPMENT

There's nothing new about dimming incandescent light . . . but there's *plenty* new about the POWERSTAT method of dimming cold-cathode fluorescent! POWERSTAT Dimmers — plus the proper integration of the components of the dimming system — make cold-cathode fluorescent dimming easy, inexpensive and effective. Select the proper lamps, ballasts and transformers — add a POWERSTAT Dimmer — and your cold-cathode dimming problems are solved.

POWERSTAT Dimmers give top performance with cold-cathode or incandescent lighting treatments. They're easy to install, rugged and maintenance-free. They'll give smooth, stepless, continuously-variable control over long periods of dependable service. Because POWERSTAT Dimmers operate by transformer action, a negligible amount of heat is generated. No special ventilation problems arise with their installation. POWERSTAT Dimmers in your cold-cathode fluorescent or incandescent circuit can be placed wherever they will be most convenient for you.

POWERSTAT Dimmers — available in numerous models and a wide range of capacities — are designed for handwheel, lever action or motor driven operation. There's a POWERSTAT Dimmer for *your* application . . . write today for complete information on what POWERSTAT Dimmers can do for you.

TYPE D1700



TYPE DM4600T

5098 DEMERS AVENUE, BRISTOL, CONNECTICUT

THE SUPERIOR ELECTRIC CO.
BRISTOL, CONNECTICUT

Powerstat Variable Transformers • Voltbox A C Power Supply • Stabiline Voltage Regulators.

Save 58 minutes of each Rodding Hour... Use

PNEUMATIC FISH LINE

an air-operated device for fishing duct: it will do the job with *fewer men* and will do it faster.

One large public utility reports that rodding by conventional methods averages $15.20 per thousand feet, but, by using the Cope Pneumatic Fish Line, the cost is reduced to $2.60 per thousand feet.

Another user reports a specific operation. "An old 5" diameter fibre duct 209 feet long, containing considerable water, was fished in 2 minutes 40 seconds—a job that would ordinarily take 1 hour and 45 minutes, and twice as many men if performed by conventional methods."

WHAT PROBLEM CAN WE HELP YOU SOLVE?

Just as Cope found there was need for a Pneumatic Fish Line and developed one now used by the Electrical Industry . . . so it can develop other products for which there is a genuine need. Have you a problem that Cope, with its 60 years of experience, can help solve?

The performance of the Cope Pneumatic Fish Line has been truly outstanding, even in the extremely long duct runs recently installed for power service in the United States, Canada, and Brazil.

You too will be able to fish underground ducts—regardless of diameter or length—in a matter of minutes instead of hours.

WRITE TODAY FOR FULL DETAILS OF THE COPE PNEUMATIC FISH LINE.

YOU KNOW COPE BY THESE PRODUCTS

T.J. Cope INC.

711 So. 50th Street, Phila. 43, Pa.

with the company for a number of years, having started in 1911 and advanced through various managerial capacities to a seat on the board of directors.

•

Mississippi Valley Group Elects Finkelnburg Head

E. H. Finkelnburg, vice-president and general manager of the Mississippi Valley Public Service Co, Winona,

E. H. FINKELNBURG

Minn., has been elected president of the North Central Electric Association for the year 1948-49.

Mr Finkelnburg joined Mississippi Valley Public Service Co as electrical engineer in 1918 and was appointed vice-president and general manager in 1943. His early experience included connections with the U. S. Steel Corp at Gary, Ind.; the Milwaukee Electric Railway & Light Co and Stone & Webster.

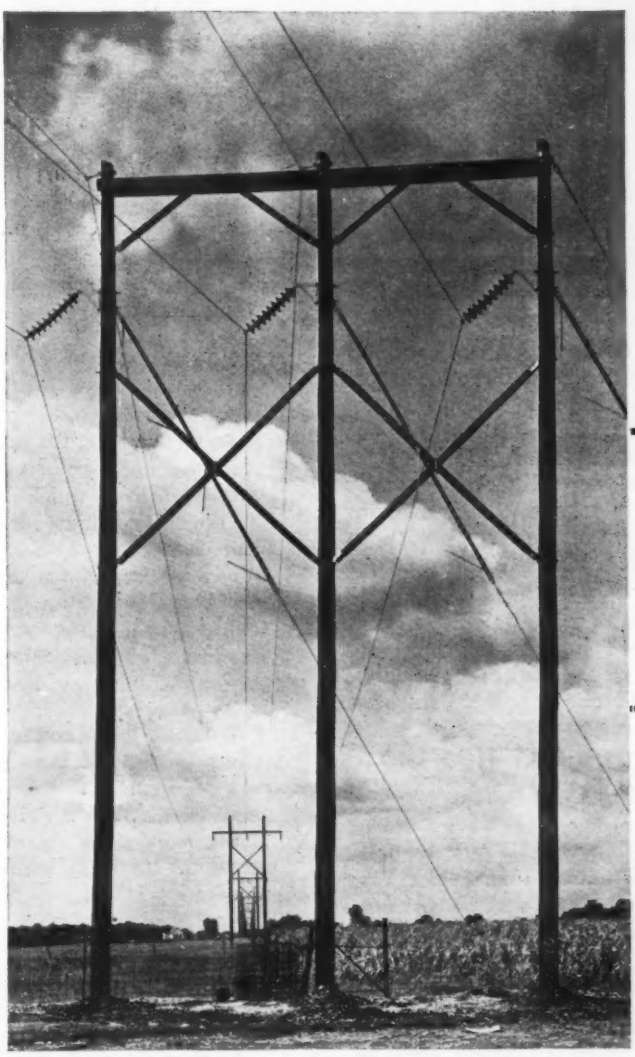
•

► PAUL B. METCALF, executive assistant to vice-president Walker Mason, Narragansett Electric Co, Providence, R. I., has been made an officer in the Order of Orange Nassau with Swords. In a decree by Queen Wilhelmina of the Netherlands, Mr Metcalf was cited for important services in the liberation of southern Holland in 1944, notably in the restoration of communications. He served in both World Wars, and as a lieutenant colonel in the latter directed the restoration of power facilities in parts of Holland and in Germany. For many years he was a steam engineer specialist in the New England Power system.

► HARLEIGH W. RILEY, commercial manager of the Indian & Michigan Electric Co, South Bend, has retired after 43 years with the company. Mr Riley was for 27 years in the company's merchandising division at Buchanan. Later he was transferred to the home office at

YOUR COMPANY CAN PROFIT from miller's

1. 30 YEARS' EXPERIENCE
2. MODERN EQUIPMENT
3. ADVANCED METHODS



• The Miller organization is an ever-ready, experienced, completely equipped construction department for any utility. Thus, there is no expense to a utility for maintaining a large construction department—no unnecessary costs and investments while your projects are in progress—no costs for temporarily expanding your own organization.

Miller takes all details off your hands yet works in full cooperation with your organization. Miller proceeds and finishes each project on schedule.

The latest mechanized construction equipment is always ready and goes into your service when Miller goes to work for you.

Find out about our experienced crews and how well they maintain good public relations during construction—learn how we can save you time and money. Call a Miller executive to confer with you.

LET MILLER DO YOUR

TRANSMISSION LINE CONSTRUCTION

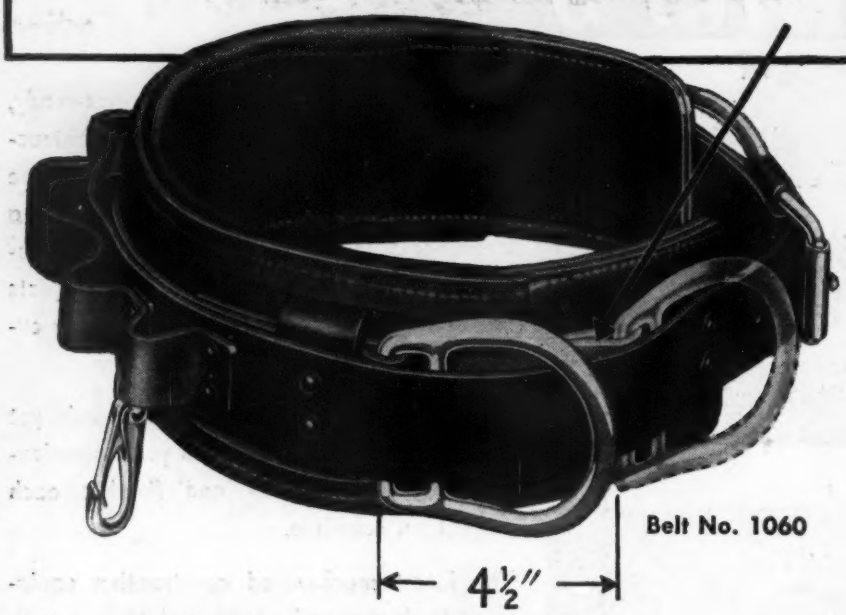
ELECTRICAL DISTRIBUTION - TRANSMISSION - ERECTION
MILLER CONSTRUCTION CO. INC.
OVERHEAD
UNDERGROUND
LINTON INDIANA

Builders of the Alaskan Highway Telephone Line—*The world's longest.*

MILLER CONSTRUCTION COMPANY, INC.

LINTON, INDIANA

Turn freely in this belt . . .



BUCKINGHAM *Glider* TOOL BELT

Yes, with this tool belt, you can turn up to 4½" right or left without binding your clothes or cramping your tools. That's because the Glider Tool Belt has a "floating" feature that allows fuller, freer body movement. Here's how: The middle belt, attached to the safety strap, does not move when you turn. The safety strap does not shift on the pole. The outer strap and inner liner slide easily without pulling or binding . . . without costly wear and tear on your clothing. Tool loops remain full and open. You can turn without tiresome, time-consuming shifting of your feet. You can change your position quickly, easily and safely.

And you can depend on the Glider Tool Belt for that all-important safety too. It's made of stout, tan-colored harness leather and stitched with tough nylon thread. It's built to the highest standards of quality to give you a good, dependable belt.

A BUCKINGHAM BELT is a good belt.

A BUCKINGHAM BELT is designed for comfort and ease of movement.

A BUCKINGHAM BELT is built to make safety a certainty.

BUCKINGHAM TOOL BELT NO. 1201

BUCKINGHAM TOOL BELT NO. 1201

A sturdy, practical tool belt built to give you years of comfortable, trouble-free service. Rolled edge leather lining. Inner belt is 4½" at back, tapering to 2½" at heel of dee ring. 2" belt strap has five tool loops and is fitted with harness ring, snap hook and tape thong. Inner belt has tab extended on each side. To these you can rivet any standard or special tool holsters or pouches.

See these tool belts at your regular supply house, or—write directly to us for Catalog 548 describing the full Buckingham line of equipment.

BUCKINGHAM MANUFACTURING CO., INC.
5-7 Travis Street Binghamton, N. Y.

South Bend to act as manager of residential sales for the entire organization, and in 1934 became commercial manager. After his retirement, Mr Riley will remain in the company service as a consultant.

•

Dr L. W. Chubb Retires from Westinghouse Labs

Dr Lewis W. Chubb, director emeritus of the Westinghouse Research Laboratories, has resigned after 43 years of scientific research for the company. Dr Chubb, who served as director of the laboratories from 1930 until assuming his honorary emeritus post last March, (EW, Apr 3, 1948, p 27) obtained more than 150 patents in a wide variety of fields.

In the course of his distinguished career, he had received many major engineering and scientific honors.

•

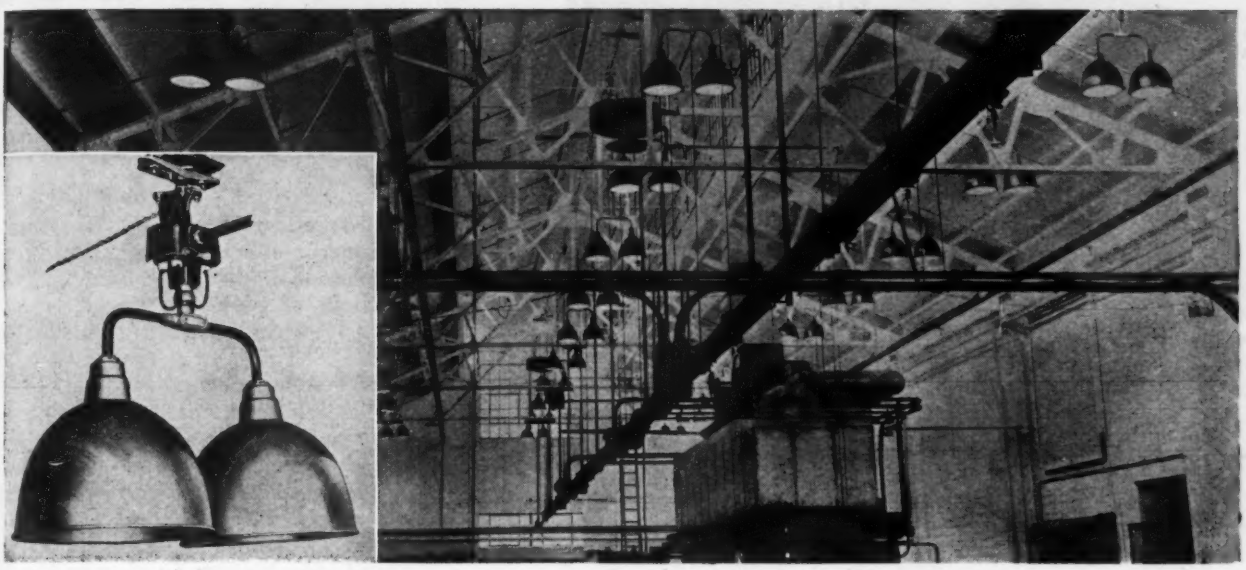
▶ H. H. Dinkins, Jr, secretary of the Electric Bond & Share Co, New York, has resigned to go into his own business in Scott, La. He will devote his efforts to retail merchandising and farming.

▶ Robert R. Wylie, formerly district manager for the Roanoke office of the Rumsey Electric Co, Philadelphia, has been appointed operating engineer with Luz Electrica de Barcelona, Barcelona, Venezuela, S. A.

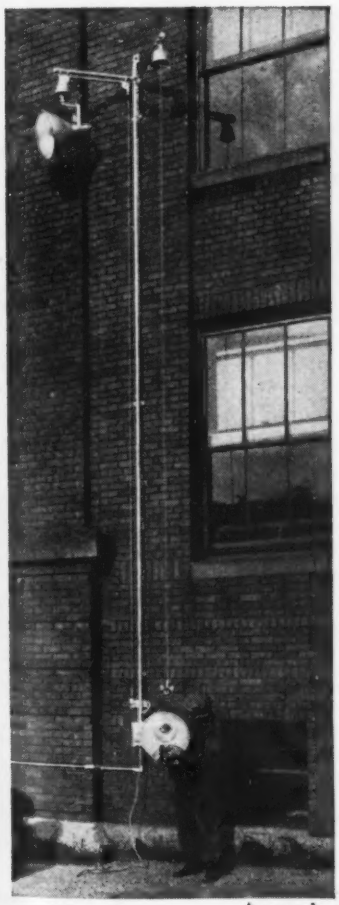
▶ Howard R. Andrews, superintendent of the Ohio Power Co's Tidd generating plant at Brilliant, Ohio, has been made superintendent of the new Philip Sporn plant now under construction at Graham Station, W. Va., which is jointly owned by the Appalachian Electric Power Co and Ohio Power Co. Mr Andrews served as superintendent for Appalachian at Kenova W. Va., from 1941 to 1943, spent the next two years as superintendent of the generating plant at Logan and moved to Brilliant in 1945.

▶ William R. Rinelli has been appointed director of Ansul Chemical Co's new customer relations department, Marinette, Wis. Mr Rinelli was formerly manager of Ansul's development division. He is well known in the refrigeration industry as the co-author of a number of technical papers and as one of the authors of "Refrigerating Data Book", published by the American Society of Refrigerating Engineers.

▶ A. A. Schueler, general sales manager of the Square D Co, western division, and treasurer of the company, has resigned. Mr Schueler has been with the Square D organization for 33 years. Prior to his position with the western division, he was the company's



INDOORS AND OUTDOORS



at heights from 16 feet to 600 feet

THOMPSON DISCONNECTING AND LOWERING HANGERS

• Provide the ACCESSIBILITY that is so necessary for low cost, quick and safe servicing of lighting units—keep adequate foot candles of illumination at work.

THOMPSON HANGERS
are applicable to suspended lighting units of practically all types within their rated capacities.

Luminaires may be incandescent filament, mercury or sodium vapor, combinations, and fluorescent lamps. They may be used for aeronautical obstruction lights including 300 MM code beacons, flood lights, industrial, commercial or ornamental.

We invite you to use THOMPSON Engineering Service.

THOMPSON HANGERS have wide adaptability, a selection of types available for — Churches — Assembly Halls — Gymnasiums — Armories—Airplane Hangars—Sports Arenas (Indoor and Outdoor) Auditoriums —Public Buildings—Industrial Plants—Parking Lots—Railway, Bus and Steamship Terminals—Stacks, Watertanks— Grain Elevators—Transmission Towers and Bridge Piers.

THE THOMPSON T·E ELECTRIC COMPANY
1101-11 POWER AVE. CLEVELAND, OHIO, U. S. A.

The Philharmonic is down on the farm

Those sounds drifting out into the night aren't what you might expect. You won't hear the groan of a parlor organ, but the deep-throated song of the cello—the full grandeur of a symphonic broadcast.

Rural electrification has not only brought labor-saving tools to the farm, but also many of the pleasures and conveniences of city life.

The electrical farm is here in the United States. Hemingray is proud to have carried an important role by supplying dependable pin-type glass insulators for medium voltage power lines. Traditional Hemingray quality is maintained in every step of manufacturing, testing and inspection.

•

Inspection of Hemingray Power Insulator No. 514 (designed for 15,000 volt lines) is conducted in accordance with Edison Electric Institute specifications TD-51-1942, as is the inspection of all Hemingray Power Insulators.

These insulators are manufactured by a pioneer company in the glass insulator field and are sold by principal jobbers.

HEMINGRAY
POWER INSULATORS
American Structural Products Company
MUNCIE, INDIANA
SUBSIDIARY OF OWENS-ILLINOIS GLASS COMPANY

national sales manager. Before that he worked in the midwest as a salesman for the company.

•

GE Assigns New Executive Duties in Electronics Dept

Creation of a new position on the vice-president's staff, with the title of manager of marketing, and the establishment of the general sales division as one of seven operating divisions in the electronics department of the General Electric Co at Syracuse, N. Y., have been announced.

E. H. VOGEL has been appointed to the new manager of marketing position and will operate at staff level. A. A. BRANDT, the department's general sales manager since 1943, will continue in that position and will manage the general sales division which now has full operating division status.

Outlining the duties and responsibilities of the manager of marketing and the general sales manager, respectively, Dr W. R. G. Baker, vice-president and general manager of the department, explained that Mr Vogel will represent the vice-president on such responsibilities as general departmental and divisional sales policies; product planning and pricing; merchandising plans and programs; advertising, sales promotion and and publicity and market research. Mr Brandt will be responsible for the sale of the department's commercial products and for operation of the field sales organization in nine districts throughout the country. He will also be responsible for establishing adequate methods and channels of distribution and for sales training programs. Mr Brandt will share with the product divisions of the department the responsibility for product planning and pricing; merchandising plans and programs; production releases and scheduling.

Mr Vogel was formerly associated with General Electric from 1936 to 1939, when he was manager of the radio sales division at Bridgeport. He returned to the company as a member of Dr Baker's staff in May of this year.

L. E. PETTIT has been appointed manager of the advertising division of the electronics department recently formed. Prior to his new appointment, Mr Pettit was assistant to the general sales manager of the department.

ROBERT S. NEBLETT has been named assistant general manager of the company's nucleonics department, with headquarters at the Hanford Works, Richland, Wash. He has served as administrator of the GE nucleonics project since last October.

New sales manager for General Electric radio and television sets in northern California and western Nevada is LOWELL GARRISON, who moved to the

WIRE IS ONLY AS GOOD AS ITS INSULATION

OVER 10 BILLION FEET of Laytex* INSULATED WIRE

THAT'S HOW MUCH U. S. RUBBER HAS MANUFACTURED IN THE 20 YEARS SINCE LAYTEX WAS PERFECTED

Laytex, 90% pure rubber insulation, is used in many U. S. wires and cables. For example, there is U. S. Control Wiring for every type of control, supervisory or metering problem. Because dependability is so vital in this service, U. S. engineers use Laytex insulation on the individual conductors of 600 volt control cable. MOREOVER, THERE HAS NEVER BEEN A REPORTED FAILURE OF LAYTEX INSULATED CONTROL CABLE IN ITS 16 YEARS OF MANUFACTURE. It is Laytex that gives you a cable of such light weight, small diameter, and high resistance to moisture.

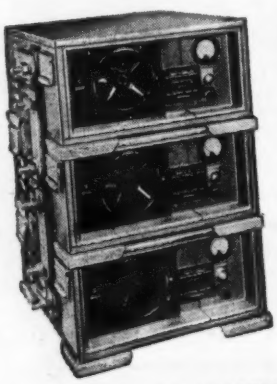
For more information and sample write to Wire and Cable Department, United States Rubber Company, 1230 Avenue of the Americas, New York 20, N. Y. *Reg. U.S. Pat. Off.

SMALLER DIAMETER MEANS MORE CABLES IN A GIVEN SPACE
U. S. Control Cable (7-conductor) insulated with Laytex
Ordinary 7-conductor Control Cable
U.S.
A PRODUCT OF
U.S.RUBBER
SERVING THROUGH SCIENCE

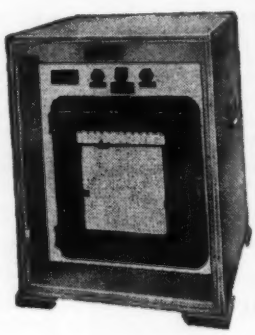
A CINCH at 1800° F.

Preheating and Stress Relieving for Welding —by the Patented Smith-Dolan System

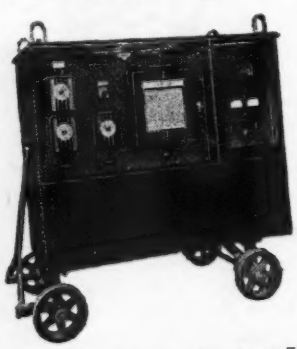
■ It's an accomplished fact that Electric Arc Induction Heaters, through the patented Smith-Dolan System, can generate heat to 1550° F and 1850° F on both chrome molybdenum and stainless steel. Here is equipment for ANY TYPE OF JOB—equipment that can be purchased outright or rented. From what other source could you possibly obtain such wide latitude in planning for every job, every problem in preheating and stress relieving before welding?



NEW MODEL U-P, Smith-Dolan System, portable, low frequency induction heater, three-high stack shown, 30 kva, 10 kva per unit.
Buy one or stack two or three for increased capacity.
Buy what you need—build as you go.



AUTOMATIC CONTROL CABINET
Used with Model U-P units (shown) and Model GC Duplex 120 or 150 kva induction heaters (shown in catalog).



MODEL BH, Smith-Dolan Induction Heater (mobile type) complete with self contained control instruments.

Electric Arc Induction Heating Equipment can be broken down to manual control, semi-automatic program control and fully automatic heat cycle program control. Operators find this equipment easy to use in field or shop, time saving and guaranteed to produce thorough penetration in heating large and heavy wall weldments. Today, more than ever, Electric Arc equipment is specified where other methods are too costly and impractical. Write for informative catalog.

ELECTRIC-ARC INC.
ELECTRIC-ARC, INC. 158 JELLIFF AVE. NEWARK 8, N. J.
WELDING EQUIPMENT, ELECTRODES & SUPPLIES

position after heading GE's western advertising and publicity department since 1944. R. W. JACKSON of GE's Schenectady news bureau has taken over the public relations functions left vacant by Mr Garrison.

OBITUARY

► JOHN A. DARLING, administrative assistant to the operating vice-president of the Boston Edison Co, died in that city on Aug 27. He was 67 years old. Mr Darling joined the company in 1901. In 1916 he co-ordinated the system dispatching facilities of the utility and was a pioneer in training women dispatchers in World War I. In 1935 he became chief of electrical operations. He was appointed assistant superintendent of production in 1940 and attained his latest position in 1944. Mr Darling was a former chairman of the New England System Operators Club. In World War II he was plant protection director.

► SAMUEL W. RUSHMORE, industrial engineer, inventor and manufacturer of Plainfield, N. J., died on Aug 17. He was the owner of the Rushmore Dynamo Works, Jersey City and Plainfield, N. J. The business was merged with Bosch Magneto Co in 1914, and since that time Mr Rushmore has operated the Rushmore Laboratory at Plainfield, N. J., developing his own patented inventions and engaging in general research work. He was a life member of the American Institute of Electrical Engineers.

► WILLIAM W. NICHOLS, a former vice-president of the Allis-Chalmers Mfg Co, died on Aug 13 at the age of 87. Mr Nichols taught at Yale University for 15 years before the turn of the century, and later was with A-C for 40 years. For many years he had headed the American Manufacturers Export Association. In addition, he had contributed many articles to publications on engineering education, foreign trade and business conduct. Mr Nichols was a member of the American Society of Mechanical Engineers, the American Iron and Steel Institute and the National Industrial Conference Board.

► HOWARD BUTT, vice-president of the William Powell Engineering Co, Cincinnati, and general manager of its New York branch, died on August 23 at his hummer home in Brielle, N. J. Mr. Butt joined the William Powell company in 1930. Before that time he had been general sales manager for Air Preheater Corp, manager of the furnace department of the Riley Stoker Co, manager of the Rust Engineering Co and electrical engineer with the Bab-

How 19,000 companies up take-home pay *without upping payrolls*

Can you deduct $18.75 from $60.00 and get $66.25? *Yes.* And the way you can do it is mighty important to your company—and to the nation!

You start with $60, representing someone's weekly take-home pay. You deduct $18.75 for the purchase of a U.S. Savings Bond. That leaves $41.25. But $41.25 isn't what the worker takes home. He takes home $41.25 *plus a $25 Savings Bond.* Total (assuming he holds the Bond till maturity): *$66.25.*

WHAT 19,000 COMPANIES HAVE LEARNED

In the 19,000 companies that are operating the Payroll Savings Plan for the regular purchase of Savings Bonds, employees have been more contented in their jobs—absenteeism has decreased—even accidents have been fewer!

Those are the "company" benefits the Plan provides, in addition to extra security for individual employees.

But the Plan has other, far-reaching benefits of basic importance to both your business and the national economy...

SPREADING THE NATIONAL DEBT HELPS SECURE YOUR FUTURE

The future of your business is closely dependent upon the future economy of your country. To a major extent, that future depends upon management of the public debt. Distribution of the debt as widely as possible among the people of the nation will result in the greatest good for all.

How that works is clearly and briefly described in the free brochure shown at the right. Request your copy—*today*—from your State Director of the U. S. Treasury Department's Savings Bonds Division.

ACTION BY TOP MANAGEMENT NEEDED

The benefits of regular Bond-buying are as important today as ever—but war-time emotional appeals are gone. Sponsorship of the Payroll Savings Plan by a responsible executive in your company is necessary to keep its benefits *advertised to your employees.*

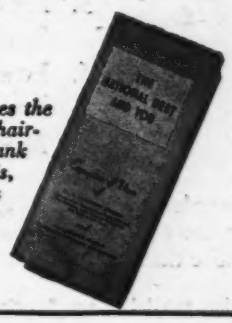
Banks don't sell Savings Bonds on the "installment plan"—which is the way most workers prefer to buy them. *Such workers want and need the Payroll Savings Plan.*

Those are the reasons why it's important to make sure that the Plan is adequately maintained in your company.

The State Director will gladly give you any assistance you wish.

"The National Debt and You,"

a 12-page pocket-size brochure, expresses the views of W. Randolph Burgess, Vice Chairman of the Board of the National City Bank of New York—and of Clarence Francis, Chairman of the Board, General Foods Corporation. Be sure to get your copy from the Treasury Department's State Director, Savings Bonds Division.

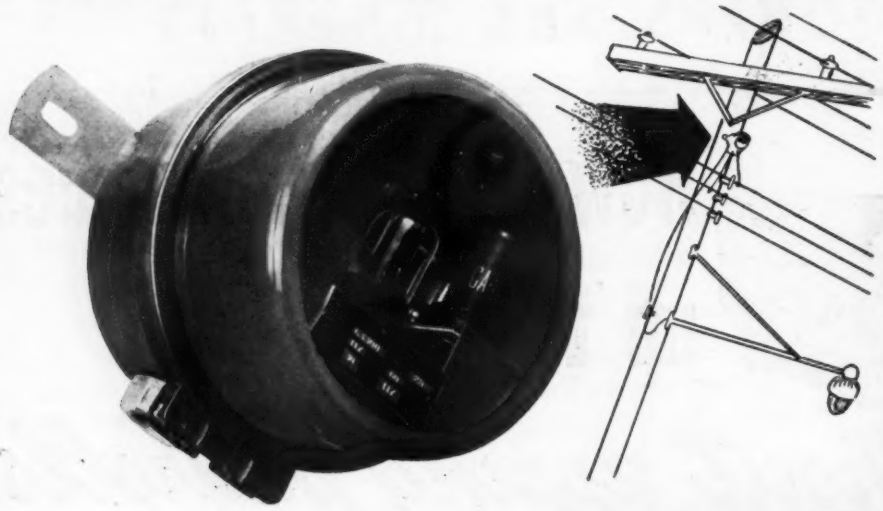


The Treasury Department acknowledges with appreciation the publication of this message by

ELECTRICAL WORLD

This is an official U.S. Treasury advertisement prepared under the auspices of the Treasury Department and the Advertising Council

NEW FISHER-PIERCE
PHOTOELECTRIC STREET LIGHT CONTROL



AUTOMATIC CONTROL For Multiple or Series Lighting

This new Series 63300 control guarantees light when it is needed — when light means the difference between safety and danger. Only a Photoelectric Control can give positive light control independent of conditions of daylight, weather or climate.

AMONG THE SPECIFICATIONS OF THE NEW SERIES 63300 ARE:

1. Contact capacity 3000 watts of incandescent lamp load.
2. Standard Watt-Hour Meter enclosure. Weatherproof. Easy to install.
3. Mounting suitable for either Crossarm or Pole Surface.
4. Low first cost — minimum maintenance. (20,000 hour nominal tube life.)
5. Models for 120 and 240 volts, 50-60 cycles.

Supplementing the earlier and successful 61300 series controls, the new Series 63300 employs the same electronic circuit. This has been proven in more than 3000 installations both here and abroad.

Also available are Special Models for Outdoor Signs, Billboards, Aircraft Obstruction Lights and other light control applications. Units can be shipped from stock. Write today for further information.

The FISHER-PIERCE COMPANY, INC.
81 CEYLON ST., BOSTON 21, MASSACHUSETTS

cock & Wilcox Co, all in New York. He was a member of ASME and the American Iron and Steel Institute.

▶ RAYMOND E. PALMER, engineer and general manager of the new United States Rubber Co's Mexico City project, died in that city on Aug 27,. He was 57 years old. After completing a United States Rubber Canadian project a year ago, Mr Palmer took over the Mexico City project. Born in Ft Wayne, Ind., he was graduated from Dartmouth College and the Massachusetts Institute of Technology two years later. Mr Palmer was a member of the ASME.

▶ PERCY P. MOONEY, electrical supervisor of the Consumers Power Co, Jackson, Mich., died on Aug 17 in that city at the age of 62. Mr Mooney had been in ill health for the past 5 years. He had been connected with Consumers Power since 1910. Positions held included chief of the statistical department, assistant division superintendent at Grand Rapids, chief load dispatcher and electrical supervisor.

▶ STEPHEN M. HAFFEY, formerly superintendent of the southern division of Columbus & Southern Ohio Electric Co, Columbus, Ohio, died on Aug 22 following an illness of several months. He was 65 years old. He retired in 1945 after 30 years with the utility. Mr Haffey was named division superintendent by the old Columbus Railway, Power & Light Co, and continued in that position when the utility was purchased by the Columbus & Southern Ohio Electric Co.

▶ JOHN E. LEAR, professor of electrical engineering at the North Carolina State College, Raleigh, died of a heart attack on Aug 17 at his summer home at Penland, N. C. He was 69 years old. Prof Lear was active in the North Carolina branch of the AIEE and was a member of the American Society for Engineering Education.

▶ D. C. CANNING, engineer with the Canadian General Electric Co, died suddenly on Aug 17 in Peterboro, Ont., after a short illness. Mr Canning had been a resident of Peterboro since 1921 and was chairman of the Peterboro Board of Education. He was 50 years old.

▶ CHARLES G. SPENCER, a retired development engineer of the Bell Telephone Laboratories, Inc, New York, died on Aug 16 of a heart ailment at his home in East Orange, N. J. Mr Spencer retired from active business life in 1946. He was a member of the American Institute of Electrical Engineers.

MANUFACTURERS and MARKETS

MASS-SPECTROMETER is used by Westinghouse Electric physicist to trace impurities in metals. The metal samples are vaporized in a small filament-type furnace. Using two milligram samples, the new method will detect as little as one part of the impurity per million. The equipment was specially devised and is not commercially available

U. S. Rubber Co Capacity Reaches Highest Peak

Post-war expansion and modernization, costing more than $80 million, has raised U. S. Rubber Co's production capacity to the highest peak in its history, Herbert E. Smith, president, has announced.

Commenting on his company's progress on the third aniversary of V-J Day (Sept 2), Mr Smith stated $30 million has been spent since the war on tire production facilities and $50 million on non-tire products.

"More than $24 million has gone into the expansion and modernization of plants producing hose, belting, friction tape, wire and other special rubber products used by the oil, automobile, electrical, railroad, steel, and other major industries; also footwear, raincoat, coated fabrics, foam mattresses and many other items in the consumer field.

"Additional millions have been invested in new facilities for the production of chemicals, textiles, and plastics . . .", he continued. "U. S. Rubber and the rubber industry in general have finally won the race between supply and demand," he said. "With the exception of a very few products, supplies of merchandise are ample and competition is growing keener. The real winner in this new market of abundance is the customer . . ."

•

Instruments Company Sold

Junius R. Clark, formerly vice-president of the Fawick Airflex Co, Inc, has purchased the entire capital stock of the Sterling Manufacturing Co, Cleveland, Ohio, from Walter M. Scott. The company was founded in 1906 and Mr Scott has been responsible for the development, improvement and diversification of the products ever since. The company produces all types of standard and special instruments, ac dc, for the electrical, industrial and radio fields.

New Appliance Financing Program Announced

Westinghouse Electric Corp has announced a new low-cost plan for financing installment purchases of electrical appliances and radios.

Designed to encourage local banks to handle the financing of appliance purchases by local Westinghouse dealers and their customers, the plan, called the Westinghouse Equity Plan, was announced last week by L. H. Lund, vice-president and treasurer.

Under the plan, the bank is relieved of problems arising when merchandise must be resold. Low-cost insurance protection against fraud hazards is made available to the bank at its option. Physical damage insurance also has been provided along with the fraud bond by a group of leading underwriters who worked out the entire program at the invitation of Westinghouse.

In return, the bank is asked to provide equitable financing for the distributor's retail dealers so they will be able to stock a full line of appliances and radios without having to deplete their working capital to pay for the merchandise in full at the time of purchase. Under the retail phase of the plan, the bank will finance individual customer purchases for the dealer.

Westinghouse also has prepared and will furnish free to banks a dealer retail agreement which completely outlines both the bank's and dealer's responsibilities under the retail section of the plan.

"To the consumer, these agreements mean more equitable financing of the appliances and radios he buys as the result of economies the plan makes possible for the local banks," explained Mr. Lund.

•

Durst Expands Plant

Consolidation of the Durst Manufacturing Co offices and plant in the new location at 11110¾ Cumpston St, North Hollywood, Calif., has been announced. The move permits an expansion of production and faster deliveries of the company's "squeeze-heat" electric wiring and soldering pliers. The Durst unit

Silicone News

DC SILICONES

The Shoemaker's Son May Go Barefoot

But when a motor manufacturer has electrical equipment that fails frequently because of high operating temperatures, he uses DC Silicone Insulation. Take an absorption type dynamometer, for example.

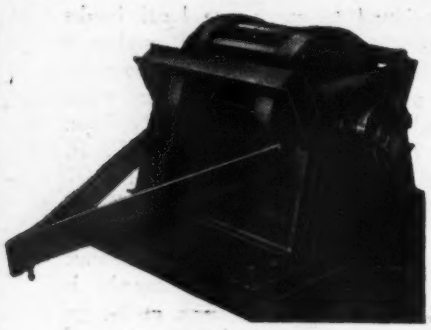


PHOTO COURTESY HOWELL ELECTRIC MOTOR COMPANY

Using a 75 h.p. frame and stator, Howell engineers designed and built this absorption type dynamometer to determine torque in electric motors. They chose this type of dynamometer because motors are easily hooked up and readings are quickly made. The idea was good but Class 'B' insulation wasn't good enough.

Average life of the windings was limited to 2 to 3 months and only motors of 75 h.p. or less could be tested without burning out the windings. To this practical problem the Howell engineers found the practical answer. After several failures they rewound the dynamometer with our Silicone (Class 'H') Insulation.

Results were even better than they hoped. The silicone insulated dynamometer has been in service now for 18 months—over 6 times the average life of Class 'B' windings—and the insulation is still in excellent condition. Furthermore, the dynamometer is being used to test motors ranging up to 150 h.p.—twice the previous capacity.

That's just another one of the many field reports that confirm the findings of our Motor Test Laboratory—DC Silicone Insulation has at least 10 times the life and 10 times the wet insulation resistance of Class 'B' under similar operating conditions. If you want more evidence of the superiority of Silicone Insulation write for leaflet G 4 A.

DOW CORNING CORPORATION
MIDLAND, MICHIGAN

Atlanta • Chicago • Cleveland • Dallas
New York • Los Angeles
In Canada: Fiberglas Canada, Ltd., Toronto
In England: Albright and Wilson, Ltd., London

Dow Corning
FIRST IN SILICONES

is comprised of the aluminum alloy pliers, a low-voltage transformer and a quick action foot switch.

•

Kingston-Conley Merged with The Hoover Co

Consolidation of the Kingston-Conley Electric Co, North Plainfield, N. J., with the Hoover Co, North Canton, Ohio, has been announced. Kingston-Conley has been a wholly-owned subsidiary of the Hoover Co since its acquisition by them in 1945.

The Kingston-Conley operation will be known hereafter as "The Hoover Co, Kingston-Conley Division." No changes in management or personnel are contemplated. Fred S. Kingston has been elected a vice-president of the Hoover Co and general manager of the Kingston-Conley Division. Brooks L. Conley will continue handling engineering and other responsibilities of the business. Mr Kingston and Mr Conley are both former Hoover executives. The Kingston-Conley Division will continue the operation of its plants at North Plainfield, N. J., and Cambridge, Ohio.

•

Raytheon Pays $1,082,300 for Government Facilities

Raytheon Manufacturing Co, New York, has purchased at a cost of $1,082,300 certain government facilities constructed during the war at Waltham, Mass.

The facilities include four major and several minor buildings containing approximately 348,000 sq ft of manufacturing, engineering, and storage space, including the war-built power tube building.

Terms of sale require Raytheon to give the United States a 20-year right temporarily to take over the facilities, if needed for national defense purposes. This right may be exercised, however, only if Raytheon is unwilling or unable to do the work for which the facilities are needed.

•

GE Awards Cable Treating Contract to Blaw-Knox

General Electric Co has placed a contract with the Blaw-Knox Co, Pittsburgh, for the construction of additional facilities at its cable treating plant at Schenectady, N. Y.

The new facilities will include large impregnators for the high vacuum drying and oil impregnation used in the insulating treatment of heavy power cable. The contract covers equipment,

have you examined your business insurance recently?

Most Management Men know that the problem of providing proper insurance protection for all risks and hazards requires highly specialized knowledge. But few firms have such specialized help available in their own organizations.

That's where EBASCO comes in!

EBASCO's Insurance Department maintains a staff of insurance specialists equipped by experience and training to analyze the diverse insurance problems of its clients. These men have developed proven procedures and methods which will immediately afford advantages to any *new* client, as well.

It should be remembered, of course, that EBASCO *sells no insurance*. Its services are *advisory* in character. They are designed to help you to determine whether your insurance program is adequate in scope and reasonable in price.

Our insurance consultants will welcome the opportunity of discussing your insurance program with you. There is no obligation for preliminary consultation.

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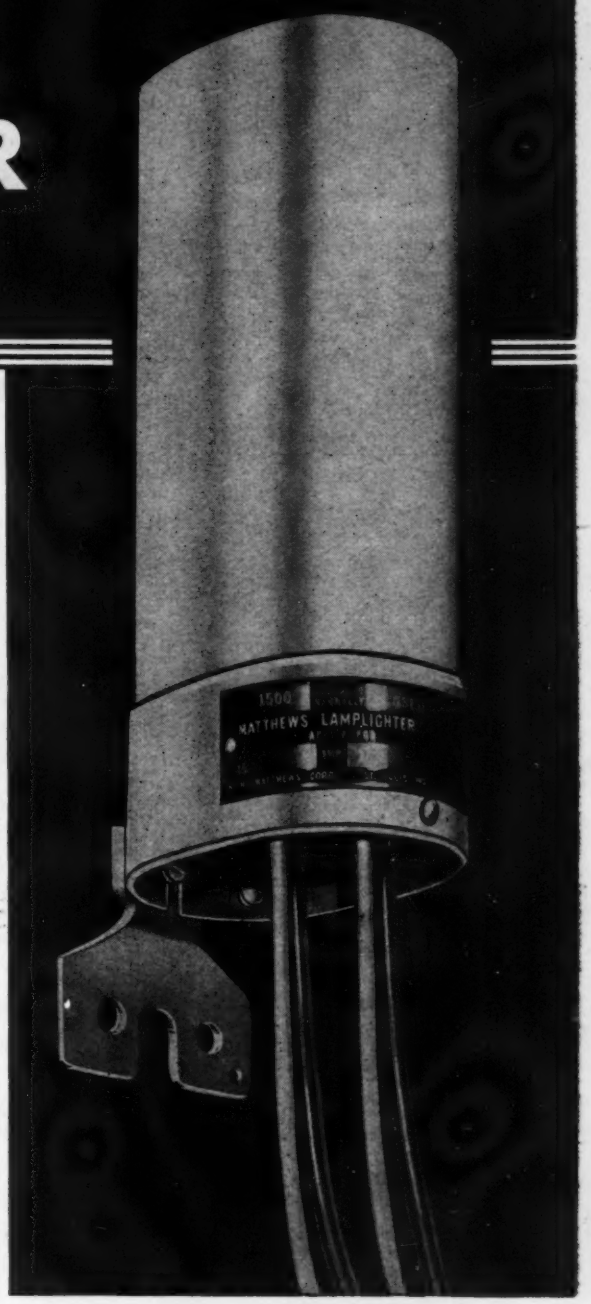
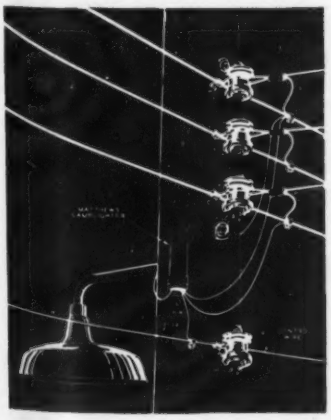
MATTHEWS LAMPLIGHTER

FOR MULTIPLE STREET LIGHT CIRCUITS



These thermally operated relays assure positive on and off operation of multiple street lights at any setting of time switch or photo electric controls. They will control any number of lamps up to their current ratings and will operate on alternating currents ranging from 100 to 120 volts, at 25 to 60 cycles. The thermal switching mechanism is designed to automatically compensate for variable temperatures within a range of +160° F. to −50° F. It is protected from the weather by a sealed aluminum housing and against lightning by gaps installed across the switch. Matthews Lamplighters are furnished with switch contacts either normally closed or normally open and can be used in the same circuit with other relays. They can be mounted on pole or crossarm by means of a lag screw and their maximum width of 2¼ inches will permit entrance in the bases of most concrete or metal street light standards. Fourteen inch long insulated lead wires are identified by color for proper connections as shown in circuit diagram on name plate. Matthews Lamplighters have been severely tested and predetermined in the laboratory. An accelerated life test corresponding to 16 years of operation showed no deterioration or fatigue of moving parts and field tests over a period of several months on numerous installations proved very satisfactory.



Cat. 1500—*15 Amp. 120 Volts—Contacts Normally Closed
Cat. 1501—*15 Amp. 120 Volts—Contacts Normally Open
Cat. 1510—*30 Amp. 120 Volts—Contacts Normally Closed
Cat. 1511—*30 Amp. 120 Volts—Contacts Normally Open
*For alternating current, single phase circuits only.

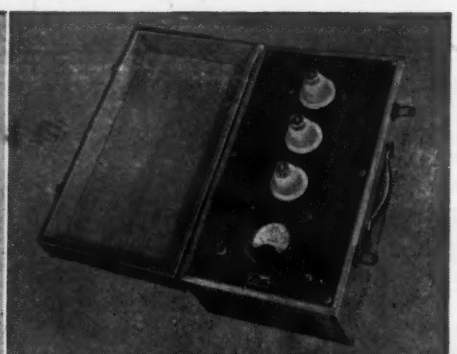
. . . WRITE FOR BULLETIN 108 . . .

W. N. MATTHEWS CORPORATION

3722 FOREST PARK AVENUE ST. LOUIS 8, MO.

ENGINEERS and MANUFACTURERS SINCE 1899

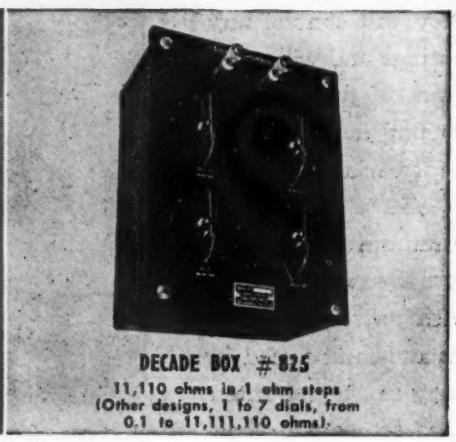
LOW-RESISTANCE TEST SET #670C
1,000 to 500,000 micro-ohms
(Other ranges from 200 micro-ohms to 100 ohms)



KILOVOLTMETER #785P
AC-DC 5-10-20 KV
(Other ranges from 1.5 to 200 KV)

Shallcross

KELVIN-WHEATSTONE BRIDGE #638-2
0.0001 ohm to 11.11 megohms
17 additional designs and 15 types of



DECADE BOX #825
11,110 ohms in 1 ohm steps
(Other designs, 1 to 7 dials, from 0.1 to 11,111,110 ohms)

. . . for electrical measurements

VOLTAGE DIVIDER (Decade Potentiometer)
10,000 ohms total. Voltage ratio: 0.001 to 1.0
(Other 3- and 4-dial designs, 1,000 to 100,000 ohms)

Shallcross Electrical Measuring Instruments are made in many types — from sturdy, inexpensive bridges for school and production use, to fault location bridges, high-voltage test equipment, low-resistance test sets and numerous others.

Write for Bulletin on any type.

AKRA-OHM PRECISION RESISTORS
14 Standard Types.
50 available special designs.

PRECISION SWITCHES
350 designs for instruments and high-grade electrical apparatus.

ATTENUATORS & CONTROLS FOR COMMUNICATION EQUIPMENT

Shallcross Manufacturing Co.
Electrical Measurement Specialists
Dept. EW-98, Collingdale, Pa.

engineering, procurement and erection services to be furnished by the chemical plants division of Blaw-Knox. The award involves approximately $400,000.

•

Manufacturers Make New Sales Assignments

Electrical manufacturing companies have recently made the following appointments to their sales staffs:

Bailey Meter Co, Cleveland, has appointed G. L. Harman, Jr, manager of the Milwaukee branch office. Mr Harman succeeds R. V. Knapp, who resigned to join the Mosinee Paper Mills Co, Inc.

Rumsey Electric Co, Philadelphia, has appointed Alvin B. Tillett district manager for the Roanoke office. Mr Tillett succeeds Robert R. Wylie, who has taken a utility assignment in Venezuela.

Hotpoint, Inc, has appointed L. E. Loveland Great Lakes district manager with headquarters at Cleveland, Ohio. Mr Loveland succeeds Walter BonDurant, who resigned to enter private business.

Pyrene Manufacturing Co, Newark, N. J., has appointed S. Carlton Williams, Jr, eastern district manager. Formerly a special assistant to the president, Mr Williams succeeds Ray Poole, who has been transferred to Chicago as sales manager of that district.

General Electric Co's chemical department will have as national distributors for the resin and insulation materials division, the Graybar Electric Co. The Graybar organization will augment the present distribution of GE insulating materials in more than 100 principal cities in the country. It will handle all GE insulating materials except friction and rubber tapes.

•

Reports Record Sales

Sales and net profits of the Thor Corp, Chicago, in 1947 were the highest in the company's history, Raymond J. Hurley, chairman of the board, announced in the recent annual report to stockholders. Sales totaling $34,461,705 resulted in profits of $3,456,720 after deduction of taxes and depreciation, the report showed. This record compares with sales of $12,535,137 and profits of $428,065 during 1946.

•

Pays Extra Dividend

Electric Controller & Manufacturing Co, Cleveland, has voted a common dividend of $3 a share, payable on Oct 1. The company paid $1.25 in each of the first and second quarters this year.

•

Offers Employees Stock

Westinghouse Electric Corp has announced it will offer 900,000 shares of common stock to its employees.

RECENT RATE CHANGES

GEORGIA POWER & LIGHT Co's general rate increase was fought recently when 25 south Georgia towns sought to have it set aside in Fulton superior court, as being "unjust, unreasonable, arbitrary and discriminatory." Last May the state Public Service Commission awarded the utility a 10% increase in residential rates and from a 25 to 50% increase in industrial rates. In his attack on the new schedule, J. B. Copeland, Valdosta attorney, charged that the Georgia Power & Light was a wholly-owned subsidiary of the Florida Power Corp. He declared that the utility, as a distributing unit, was under contract to purchase all of its power from the Florida Generating Co and that this prevented it from seeking more advantageous power purchases. L. E. Patrick, Waycross attorney for the company, denied that the company was required to buy power only from the Florida company. He said that the contract had been amended last June to enable the company to "purchase power at more advantageous rates if it desires," and even set up its own generating plant. Mr Patrick also denied the charge that users of Georgia Power & Light energy "paid rates for power which were higher than rates of all other public utilities in Georgia."

CONNECTICUT POWER Co, New London, proposes to include fuel charges on all bills for electricity. Large industrial and commercial customers have met such charges hitherto. At present fuel costs, these will amount to about 2 mills per kwhr for residential customers. This would add 10¢ a month to the bill of a residential customer using 50 kwhr, 20¢ for 100- kwhr users, etc. The company's related plants use about 1 lb of coal per kwhr, so an increase of $1 per ton in coal cost adds about 1/20¢ to the production cost, exclusive of distribution expenses. President Samuel Ferguson stated that considering the rise in fuel and payroll costs since 1946, the 5% gain in gross revenue expected from the fuel clause application to both electric and gas rates will be relatively small. Unless present price trends are reversed the anticipated $300,000 addition to net income after taxes will not meet financing needs and other operating cost increases. The 25-year record of ever lower prices is seemingly at an end. It appears that the company is at the beginning of a period in which electric price increases must inevitably follow further rises in the prices of labor and materials.

SOUTHSIDE ELECTRIC COOPERATIVE, Crewe, Va., has been authorized by the state Corporation Commission to increase its rates ½ cent a kwhr on all schedules. The higher rates became effective on Sept 1. The rate increase, according to C. S. Hooper, Jr, cooperative manager, was requested to meet increased operating costs and to produce sufficient income to maintain the business of the cooperative in a sound financial and physical condition.

BLUFFTON, IND., City Council has approved a reduction in the general power rate from 2 to 1½¢ per kwhr for consumers of more than 20,000 kwhr a month. The reduction will affect about half a dozen industrial users, but it is hoped the low rate will attract more industries. The reduction has been approved by the state Public Service Commission and became effective on Sept 1.

only... FRANKEL FLEXILUGS
Underwriter Approved

offer you these five EXTRA ADVANTAGES

★ 100% conductivity in all current carrying parts.

★ 100% commercial thread on nut and set screw . . . a non-stripping combination.

★ 100% wire protection with rigid pressure distributing shoe; screw never touches wire.

★ Seamless drawn tube housing gives 150% strain safety factor.

★ Cadmium plating eliminates heating caused by formation of high-resistant copper oxide, and permits use with aluminum and steel cables.

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Flexilugs are precision-built to make up tight and stay tight . . . get tough jobs done faster, easier. Three sizes take all wire sizes from 4/0 stranded to #14 solid, and give equally dependable service on stranded, flexible or solid wire.

A quality lug . . . at a practical price.

engineered

Materials selected for each part in FRANKEL *Flexilugs* are determined by exact service requirements of that part.

All parts are interlocked into one integrated unit . . . they cannot work loose or drop out.

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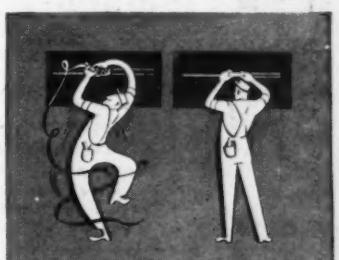
Keep Frankel Flexilugs handy . . . you'll use them every day!



It's easier and faster when you use Frankel Solderless Connectors

Send for September 1, 1948, revised price list.

SOLD THROUGH LEADING WHOLESALERS ONLY

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FRANKEL CONNECTOR CO.
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42 YEARS OF KNOW-HOW IN SOLDERLESS CONNECTORS

SCIENTIFIC WIRE STRINGING *Paid Off*

When temperatures drop, wires tighten up unmercifully. This was demonstrated repeatedly last winter when sub-zero weather caused wires to snap, and too-tight wires combined with heavy sleet and ice to bring many poles to the ground.

Some spans stayed up beautifully in the worst ice, sleet and wind of the season. They were the wires strung with Dillon Dynamometers to exact tensions recommended by the wire manufacturers. They were the ones where the relatively small cost of scientific wire stringing paid off.

As insurance against the next bad storms, check all guy and conductor tensions with Dillon Dynamometers. It isn't necessary to cut the wire. Above all, string all new wires the safe, scientific way.

Dillon DYNAMOMETER

The Dillon Dynamometer was created expressly for wire stringing. It's light in weight, compact and easy to use. Can be worked with a rope block, chain hoist or truck winch. It's dead accurate.

TO GET YOUR *free* COPY

of the "Rules of Successful Wire Pre-Stretching and Stringing," written by experienced linemen, drop us a note today.

W. C. Dillon & Co., Inc.

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TRICO Safe Time-lag

"POWDER-PACKED" RENEWABLE FUSES

They're "Different" — CUSTOM-BUILT—Give THREE TIMES THE FUSE SERVICE. The choice of discriminating engineers everywhere who insist upon:

- Top-notch Performance.
- Maximum Dependability.
- Tamper-proof Protection.
- Complete Assurance Of Trouble-free Service.

Write For Booklet 206-A

TRICO PRODUCTS are familiar to most quality-minded electric utility men. Advanced design . . . precision manufacture . . . record of performance have spread their use far & wide. TRICO will help you secure TOP PERFORMANCE and BIGGER PROFIT LOADS.

TRICO'S Famous "KANTARK" FUSES

Yes, famous because thousands of installations have proven TRICO "Kantark" superiority through years of positive, trouble-free service.

Write For Bulletin No. 1

TRICO Safety

FUSE PULLERS

Provide LOW COST insurance against accidents and consequent compensation costs. . . Speed up fuse replacement. . . Handy for adjusting fuse clips.

- EVERY ELECTRICIAN SHOULD CARRY ONE.
- HANG ONE AT EVERY SWITCHBOARD
- PLACE ONE IN EVERY TOOL KIT.
- HANG ONE AT EVERY FUSE BOX.

Write For Bulletin No. 5

TRICO FUSE MFG. CO. Milwaukee Wisconsin FUSES

NEW ELECTRICAL CONSTRUCTION

NEW ELECTRICAL construction projects announced by private and government utility systems involving more than $70,000. Also listed are major industrial and construction jobs where electrical work is included

UTILITIES

Proposed Construction

Arizona and Nevada—Bur. Reclamation, Dpt. Interior, Bldg. 1A, Denver Federal Center, Denver, Colo., one or two kva generators for units A3 and A4, Hoover Power Plant, Boulder Canyon Project. Spec. 2396. L. N. McClellan, chf. engr.

California — Bureau Reclamation, Dtp. Interior, Bldg., 1A, Denver Federal Center, Denver, Colo., 31 electric-unit heaters for Keswick Power Plant, Central Valley Project. Spec. 2394. L. N. McClellan, chf. engr., Bldg. 1A, Denver Federal Center, Denver, Colo., Plans deposit $1.

Calif., Anderson—Pacific Gas & Electric Co., 345 Market St., San Francisco, substation enlargement, **$130,000.**

Calif., Moss Landing—Pacific Gas & Elec. Co., San Francisco, steam operated electric generating plant. Over **$300,000.**

Fla., Tallahasse—City, electric generating plant, Reynolds, Smith and Hills, Box 4817, Jacksonville, engrs.

Georgia — Washington Co., Electric Membership Corp., Sandersville, 491 mi. rural distr. lines, sys. imprvs., 15 mi. tir line and two-way radio communication sys. **$765,000.**

Idaho—Fall River Rural Electric Co-operative, Ashoton, 53 mi. rural distr. lines, sys. imprvs., headquarters facilities, completing previously approved construction, Fremont Co., **$350,000.**

Ill., Peoria—State, Springfield, power plant, incl. general work, boilers, stokers, turbine generators, power piping, heating, plumbing, etc. at Peoria State Hospital, **$1,250,000.**

Iowa — Rideta Electric Co-operative Mount Ayr, 163 mi. rural distr. lines, sys. imprvs., 1 mi. tie line and completing previously approved construction. Ringgold Co., **$420,000.**

Kansas — Jewell-Mitchell Co-operative Electric Co., Inc., H. A. Totten, mgr., Ionia, approx. 250 mi. rural electric lines, incl. single and multi-phase 7,200 volt lines, Proj. Kansas 7K, Jewell Co., over $350,000. Raymond H. Reed & Co., Columbus, Neb., engr.

La., Jonesboro—Town, J. O. Tabarlet, mayor, Jonesboro, installing engine generator set, etc. in power plant, Pan American Engrs., 1418 3 St., Alexandria, engrs.

Mississippi—Four-County Electric Power Assn., Columbus, 319 mi. rural distr. lines, sys. imprvs., 68 mi. tie line, completing previously approved construction, Ortibbeha Co., **$1,560,000.**

Miss., West Point—City, c/o city clk., repairs and imprvs. to electric distr. sys. Plans deposit $10.

Missouri—Laclede Electric Co-operative, R. E. Riggs, pres., Lebanon, addnl. rural distr. lines, sys. imprvs., extens., Laclede Co. and vicinity, **$780,000.**

New Mexico—Southwestern Rural Electric Corp., Roy M. Brown, secy., Clayton, 470 mi. rural distribution lines, Union Co., **$550,000.** Hollis W. Harris, Johnson Bldg., Amarillo, Tex., engrs.

N. M., Los Alamos—U. S. Atomic Energy Comn., Los Alamos, underground telephone conduit and white way lighting for Los Alamos Proj., Inv. No. 291-49-28. Plans deposit $15.

North Dakota—Capital Electric Co-operative. Bismarck, 394 mi. rural distr. lines, Burleigh Co. **$610,000.** REA allot.

North Dakota—North Central Electric Co-operative, Bottineau, 996 mi. rural distr. lines, Bottineau Co. **$1,400,000.** REA allot.

N. D., Grand Forks—Minnkota Power Co-operative, Grand Forks, power plant, pumphouse, water discharge structures, ash storage silo, coal handling equip. traveling crane, water screens. Ellerbe & Co., 1st. Natl. Bank Bldg., St. Paul, Minn., engrs.

Texas — Bailey County Electric Co-operative, Assn., Muleshoe, 215 mi. rural distr. line, sys. imprvs. 48 mi. tie line, headquarter facilities, Bailey Co. **$430,000.** REA allot.

Texas—Kaufman County Electric Co-operative, Kaufman, 60 mi. rural distr. lines, sys. imprvs., headquarters facilities, Kaufman Co. **$150,000.**

Virginia—U. S. Eng., Fort Norfolk, Norfolk, three 41,000 kva. one 15,000 kvs. three-phase power transformers and accessories for Buggs Island powerhouse on Roanoke River near Antlers. Inv. Eng-44-110-49-42.

Washington—Bonneville Power Admin., 729 N. E. Oregon St., Portland, Ore., 19.42 mi. Scenic-Index Sect. of Foster Creek-Snohomish 230 kv transmission line, No. 316, King and Snohomish Counties. Plans deposit $25.

Low Bidders & Contracts Awarded

Georgia—Three Notch Electric Membership Corp., Donalsonville, 500 mi. rural power lines, Seminole, Early, Miller, Clay and Decatur Counties, force account, **$700,000.**

Kansas — Jewell-Mitchell Co-operative Electric Co., Inc., H. A. Totten, mgr., Ionia, approx. 493 mi. rural distr. lines, incl. single and multi-phase 7,200 volt lines and one substation, Proj. Kansas 7L, M and N, Jewel Co., $750,000. Raymond H. Reed & Co., Columbus, Neb., engr.

Missouri—Sac-Osage Electric Co-operative, Inc., C. P. Longacre, pres., Eldorado Springs, Mo., labor only, 141.46 mi. rural distr. lines, Vernon, Cedar, Dade and St. Clair Counties, to C. & S. Engineering & Constr. Co., Shelby, N. C. **$75,736.** Bids 7/27.

Mo., St. Louis—Moloney Electric Co., 5390 Bircher Blvd., Zone 20, 1 story, 90x126 ft., all-metal electric transformer mfg. plant addn., incl. rein.-con. fdn., to Widmer Engineering Co., 122 N. 7 St., Zone 1. Approx. **$100,000.**

North Carolina—Piedmont Electric Membership Corp., Hillsboro, 272 mi. rural distr. lines, Alamance, Person, Caswell, Durham and Orange Counties to McKinley Constr. Co., Arlington, Va., **$129,843.** Bids 8/16.

Texas—West Texas Utilities Co., Paducah, 30 mi. 66,000 volt transmission line, sub-station remodeling, near here, force account. Approx. **$165,000.**

Washington—Bureau Reclamation, Dpt. Interior, Building 1-A, Denver Federal Center, Denver, Colo., Aug. 26, three 5,000 amp. bus structures with current and potential tranformers, grounding switches, generator protective equip. for units R4, R5, and R6, Spec. 2275, Columbia Basin Proj., from I-T-E Circuit Breaker Co., 19 and Hamilton Sts., Phila., Pa. **$208,932.**

Wis., Waupun—Dpt. Pub. Welfare, Madison, Aug. 24, power house from Fluor Bros. Constr. Co., Oshkosh, **$604,697.**

INDUSTRIAL, COMMERCIAL & PUBLIC BUILDINGS.

Proposed Construction

Md., Salisbury — Wicomico Co. School Comrs., J. H. Bennett, supt., Court House, high school, Long Ave. and Mt. Hermon Rd., **$2,000,000** to **$3,000,000.**

O., Ashtabula—Ashtabula General Hospital, Lake Ave., plans by Conrad, Hays, Simpson & Ruth, Hanna Bldg., Cleveland, brick, stone, rein.-con. hospital. **$1,300,000.**

Okla., Ponca City—Continental Oil Co., Ponca City, repairing, modernizing thermo for catalytic cracking plant, $1,000,000; refinery expans. $5,500,000.

Tex., Houston—Texas Children's Foundation, c/o Dr. David Greer, 3720 Fannin St., plans by Martin, Niven & Cooper, 3908 Main St., engrs. and archt. children's hospital. **$3,000,000.**

Low Bidders & Contracts Awarded

Calif., San Francisco—Dpt. P. Wks., City Hall, Aug. 25, 10 rein.-con. bldgs. comprising Youth Guidance Center, (juvenile detention home) Job 697, from Monson Bros., 475 6 St., **$2,110,934**; Job 697A, mechanical work from Herman Lawson, 465 Tehama St., $675,297; Job 697B, electric work, from H. S. Tittle Co., 85 Columbia Sq., **$171,680.**

N. C., Fletcher—Cranston Paint Work Co., Fletcher, plant to Potter & Schackelford, Inc., Greenville, S. C. **$3,500,000.** J. E. Sirvine & Co., Greenville, S. C., engr.

In that SPLIT-SECOND
before the breakers opened...
do you want to know what happened?
How long did it take to trip the breaker?
What was the peak fault current?
What were the power surges like?
LET THE RS-9 AUTOMATIC OSCILLOGRAPH TELL YOU!
12 elements: voltage, current, or power
2-millisecond starting
Full-automatic or manual operation
Self-contained—up to 3 starting relays
10"-chart, accurate fine-line records
Simple to use and service
For switchboard mounting or portable use
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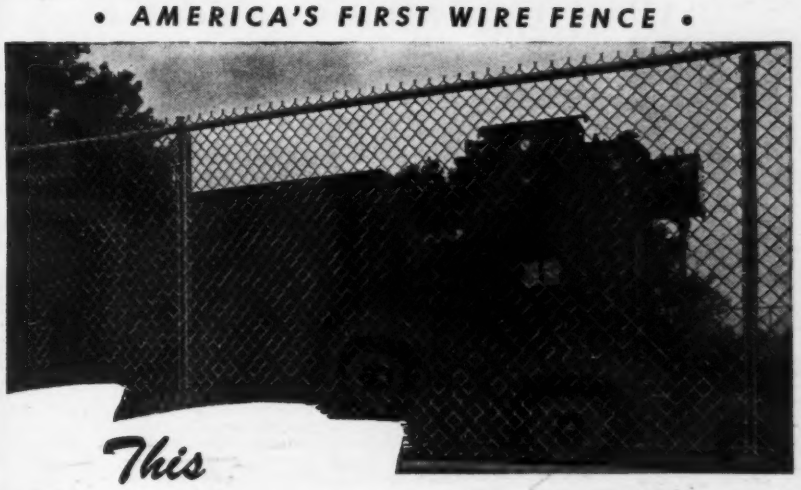

This Fence Specialist is worth knowing

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For name of nearest member firm, write to PAGE FENCE ASSOCIATION in Monessen, Pa., Atlanta, Bridgeport, Chicago, Denver, Detroit, Los Angeles, Philadelphia, Pittsburgh, New York or San Francisco

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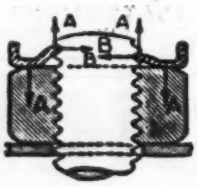
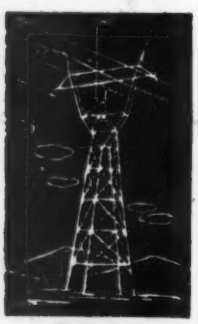
Arched, slotted jaws grip the bolt like a chuck (B-B), while spring tension is exerted upward on the bolt threads and downward on the regular nut (A-A), securely locking both.





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TECHNICAL LITERATURE

Lighting—*RLM Standard Specifications for Industrial Lighting Units* is a 36-page booklet containing detailed specifications for fourteen commonly employed incandescent and fluorescent units. Copy may be obtained from RLM Standards Institute, 326 West Madison St, Chicago 6, Ill.

Fans—*Fan Engineering*, 5th edition, has numerous charts and tables on air, its movement and distribution in air conditioning, combustion, conveying and other applications employing fans. This handbook of 808 pages, price $6, has been made available by Buffalo Forge Co, Box 985, Buffalo 5, N. Y.

Filing—*Filing Systems for Engineering Offices* is a selected list of 41 references to books and articles on systems for the filing of notes, correspondence, abstracts, reprints, drawings, catalogs, etc. An annotation summarizes important features of each article. The bibliography is issued by Engineering Societies Library, 29 West 39th St, New York 18, N. Y. Price $2.

Wire and Cable—*Standards for Rubber Insulated Building Wire and Cable*, for types R, RH and RW, have been issued by National Electrical Manufacturers Association, 155 East 44th St, New York 17, N. Y. Some subjects included are conductor, insulation, methods of making physical and electrical tests, coverings servings, lead sheath, and assembly of multiple conductor cable.

Truck Restrictions—The 1948 Truck and Trailer Size and Weight Restrictions Booklet explains graphically the differences between the motor vehicle laws of the 48 states. Copies of the booklet are distributed by Four Wheel Drive Auto Co, Clintonville, Wis.

Welding—A vest pocket welder's guide gives characteristics of various welding arcs, four essentials of welding procedures, causes of common welding troubles and what to do about them, and welding symbols. Copy is obtainable from Hobart Brothers Co, Hobart Square, Troy, Ohio.

Lighting — A "Calcu-light-or" approximately 4 in. by 8½ in. includes technical information necessary to make illumination calculations either by the lumen or point-by-point methods. This lighting calculation slide rule is available for $1 from Westinghouse Electric Corp, P. O. Box 868, Pittsburgh 30, Pa.

Plastics—The *1948 Modern Plastic Encyclopedia* lists physical, mechanical, thermal, electrical and chemical properties, gives information on ASTM test methods, provides information on molds and applications for plastics. The 1667-page volume with 12 charts can be obtained for $8.50 from Modern Plastics Encyclopedia, 122 East 42nd St, New York 17, N. Y.

Synthetic Fabrics—Nylon and Fiberglas fabrics, their properties, applications and descriptions are included in an 8-page technical bulletin. The publication is issued by the fabric manufacturer, The Duplan Corp, 512 Seventh Ave, New York 18, N. Y.

Aluminum—Former and present temper designations are outlined, also temper conversion tables for nonheat-treatable and heat-treatable wrought aluminum mill products are presented, in *Technical Advisor*, Vol 1, No. 8, 1948, issued by Reynolds Metals Co, 2500 South Third St, Louisville 1, Ky.

Stainless Steel—Composition of austentic stainless steel AISI type and their properties for comparison with carbon steel, aluminum, nickel, copper, magnesium and beryllium, are listed in tables presented in *Tempil Topics*, Vol 3, No. 7, 1948, issued by Tempil Corp, 132 West 22nd St. New York 11. N. Y.

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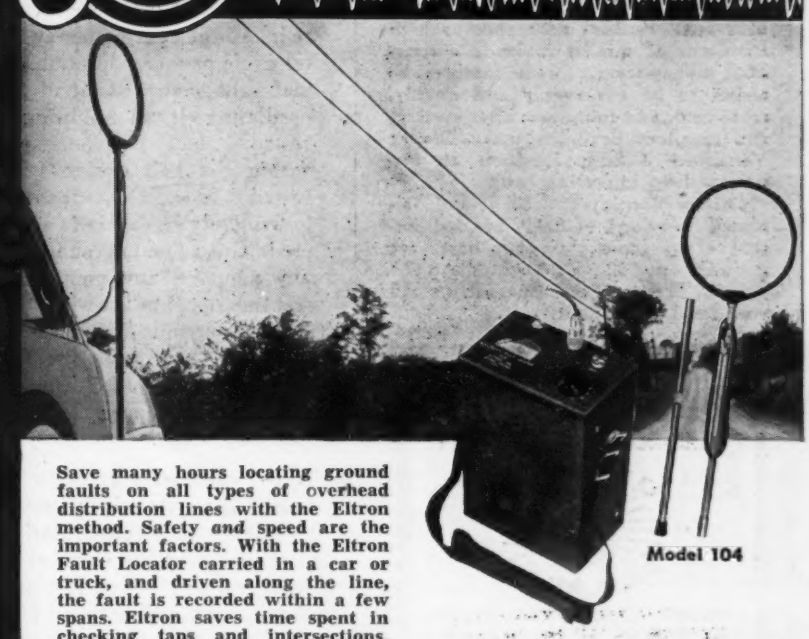
Eltron FAULT LOCATOR



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LETTERS TO THE EDITOR

To the Editor of ELECTRICAL WORLD:

In re Professor Rachel's letter on Bonneville Breaker Tests that appeared in Electrical World of June 5, 1948, p 224, we believe that Professor Rachel after seeing the more detailed report on these tests (with typical oscillograms) as was published in the AIEE paper by A. Dovjikov and C. Diemond "Performance Tests of the AEG (German) Free-jet, Air Blast, 2500 Mva Reclosing Circuit Breaker" (AIEE 48-43) understands better what kind of restrikes the American engineers have in mind when we insist that a high voltage line breaker feeding a long line should not have more than one restrike.

The restrikes during opening of long high voltage line charging current are objectionable because they may produce overvoltages—so called switching surges—but it should be clearly understood the period of arcing immediately following the contact separations does not constitute restrikes. To make it clearer we cite the corresponding paragraph from the Bonneville Power Administration specifications for high voltage breaker:

> "Restrikes shall be limited to a time of one-half cycle from the point at which the restrike begins and there shall be no recurrent restrikes after this one-half cycle of time. The arcing period shall be distinguished from the restrikes and the first restrike to be counted shall be preceded by a current zero of approximately one quarter cycle or more duration. The normal voltage decrement of the freely oscillating circuit following the final restrike shall not be counted as within the half cycle of allowable restrike time. Each phase shall be individually measured and considered. Crest line-to-ground voltages at any point on any nominal 230 KV transmission line on which current is being interrupted, as measured with a cathode ray oscillograph or gaps, shall be limited to 3.5 times the maximum value of normal cycle line-to-ground voltage.

As we consider very actively the decrease of the system insulation level for high voltage lines (particularly 230 KV and above) even the value of 3.5 times normal voltage is considered now as too high and the elimination of restrikes as source of overvoltages becomes even more important.

Alexander Dovjikov
Chief, Eng. Dept.
Analysis and Research Section
Bonneville Power Administration

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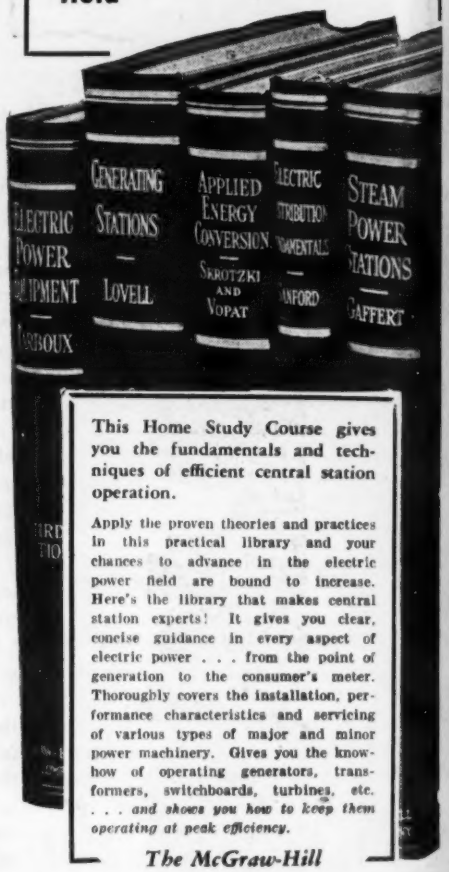

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